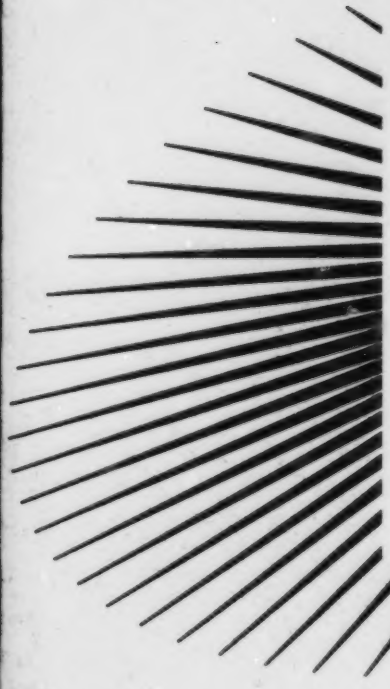
P R O P O S A L

QUÉBEC'S ENERGY EFFICIENCY STRATEGY



A contribution to sustainable development

Québec

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PROPOSAL

QUÉBEC'S ENERGY EFFICIENCY STRATEGY

A contribution to sustainable development

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Gouvernement
du Québec

Deputy Prime Minister and
Minister of Energy and Resources

Energy is the very basis of the functioning of modern societies. The progress and development of our activities as well as our quality of life are directly related to the availability of energy resources and to our ability to transform them into work or heat.

As we draw near to the XXI Century, several questions arise regarding our next energy challenges, the various choices and options before us, the organizational methods we intend to adopt both to achieve the objectives we shall set for ourselves and to implement our orientations.

The Parliamentary Committee on the Prospects of Electricity Supply and Demand held in May 1990 has helped us come to grips with a few of these questions. More generally, all energy issues are the subject of ongoing discussion.

One of these issues has priority over all others: it concerns energy efficiency, that is, the efficiency with which we use and consume the energy resources at our disposal. The production, development and use of energy do affect the environment, do have an impact on the functioning of our economies. Energy must therefore be used wisely, and the efficiency with which we use energy resources becomes both a performance criterion and a condition of future development.

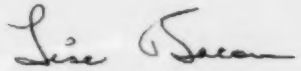
We, in Québec, enjoy a very privileged situation: in hydroelectricity, we benefit from an abundant, low-cost, renewable energy source, which helps us avert some environmental problems of grave concern. Finding ways to use energy more efficiently appears necessary and offers numerous advantages.

In response to the commitment I made on behalf of the government in December 1990, **Québec's energy efficiency strategy** reflects above all a conviction: with energy efficiency, Québec has available an additional means to meet several of the many challenges that we, like all industrialized societies, are now facing: the challenge of increasingly stiff international competition; the challenge of excellence; and the challenge of "sustainable development," that is, of growth that protects the well-being of future generations no less than that of the present one.

The government must mobilize wills, harmonize public and private actions through cooperation and partnership, and integrate the various initiatives in a comprehensive, clear and coherent plan. This is the goal of **Québec's energy efficiency strategy**.

Over the next few months, hearings will be held on this strategy so that all interested individuals and groups can give their opinion on the quantifications made and the measures contemplated. Once these hearings are completed, the government will begin to implement the measures it finally decides upon, thus initiating a developmental process. Once the measures have been implemented, we must appraise the results without delay, and not hesitate to complete and improve the actions taken, with the collaboration of all the partners concerned.

Québec's energy efficiency strategy is therefore a crucial stage towards a more efficient use of energy. With the cooperation of all the partners concerned, this program should help Quebecers bring about **sustainable development** and enable Québec to take up the gauntlet in the energy sector in the years to come.



Lise Bacon

TABLE OF CONTENTS

SUMMARY 1

INTRODUCTION 11

1 OBJECTIVES 13

The Objectives Sought 15
Economic Development 15
Consumer Benefits 15
Environmental Protection 15
Security of Supplies 16

Context of Government Action 16
The Notion of Energy Efficiency 17
Québec's Energy Efficiency Performance 18
Sustainable Development 22
International Context 23
Québec Context 24
Partnership 27

Theoretical Potential and the Objective to Achieve 29
Theoretical Energy Efficiency Potential 29
Energy Efficiency Objective to Achieve 31

2 MEASURES 35

Framework of Government Action 37
Role of the State in Energy Efficiency 37
Nature of Government Actions 38
The Bureau de l'efficacité énergétique 39
Hydro-Québec's "Energy Efficiency Project" 40

General Measures 42
Information and Public Awareness Programs 42
Support for Research and Development 42
Education, Training and Upgrading 43
Adapting the Programme de productivité énergétique 43
Establishing a Guarantee Fund 44
Laws and Regulations 44
Electricity Rate Structure as an Energy Efficiency Tool 45

Residential Sector 46
The Tools of Consumption Management 46
"Energy Rating" of Buildings 46
Other Measures Relating to the Residential Sector 46

Industrial Sector 48
Cooperation and Group Action through Sector-based Committees 48
Circulation of Specialized Information 49
Research and Development in the Natural Gas Sector 49

Institutional and Commercial Sector 49
Preparation of an Integrated and Permanent Energy Management Program for Public and Parapublic Establishments 50
Participation of Municipalities and RCMs 50
Adapting "Forum Énergie" Discussions to the Commercial Sector 51
Incentives to Acquire Gas Technologies 51

Transportation Sector 52
Encouraging the Use of Public Transportation 52
Improving the Efficiency of Existing Motor Vehicles 53
Transportation of Merchandise 53
Land-Use 53
Support for Research and Studies in the Transportation Sector 54
Information and Public Awareness: Speed Limits 55

3 FINANCING 57

The Government Will Accept Its Responsibilities 61

Energy Efficiency: a Shared Responsibility 61

Financing That Must Be Coordinated 62

Objective: Free up Annually 10 Million Dollars for Energy Efficiency 63

4 IMPACTS 65

Employment and Economic Activity 69

Activity and Jobs Created 69

Characteristics of Jobs Created 70

Macroeconomic Impacts 71

Microeconomic Impacts: Examples 73

Single-family Housing 73

Commercial Buildings 73

Pulp and Paper Mills 73

Mid-size Cars 73

Environmental Benefits 75

International Dimension 75

Different Impacts Depending on the Energy Source 75

CONCLUSION 77

GLOSSARY 79

TABLE OF FOLLOW-UPS 85

TABLE OF GRAPHS 87

All terms followed by an asterisk (*) in the text refer to the glossary on page 79.

SUMMARY

Québec has already made significant progress in using energy more efficiently. Efforts, however, must not stop at the results achieved thus far. Together we can further improve the way we consume energy. **Québec's energy efficiency strategy** is designed to support and coordinate this common project based on real energy efficiency potential as well as workable concrete actions and measures. The impacts of greater energy efficiency will be considerable, as well as the spinoffs created.

1 OBJECTIVES

A) THE OBJECTIVES SOUGHT

In proposing an energy efficiency strategy, the gouvernement du Québec is basically pursuing four goals:

- Strengthen Québec's *growth* and *economic development*.
- Improve the situation of *energy consumers*.
- Protect and respect the environment in view of achieving *sustainable development*.
- Reinforce Québec's *security of energy supplies*.

B) CONTEXT OF GOVERNMENT ACTION

Québec's energy efficiency strategy has been defined and will be applied in a context that must be determined:

- The notion of energy efficiency must be spelled out. **Québec's energy efficiency strategy** is aimed primarily at consumption, where lack of information and financial problems prevent economic rationality from holding full sway. Moreover, it is not enough to enhance energy efficiency; improvements must be made where the economy will most benefit from them.
- This strategy applies to Québec, often portrayed as an energy-intensive society. In fact, a more accurate analysis of "energy intensity" as applied to Québec's economy leads us to significantly qualify this judgment. Placed in perspective, the results obtained by Québec are quite encouraging. Québec, a region with abundant resources, has continually improved its energy efficiency performance while pursuing its economic development.
- One of the goals pursued by **Québec's energy efficiency strategy** is to help protect and respect the environment so as to foster "sustainable development." The concept of sustainable development implies development and growth, but gives priority to policies that favour adopting solutions with the least environmental impact.

Among the most important, but also the most difficult, ecological limitations to identify are "biospheric cycles": the sulfur, nitrogen and carbon dioxide cycles. Energy production and consumption are among the factors that most disrupt these cycles. Measures aimed at sustainable development, therefore, entail action on how energy is used.

- **Québec's energy efficiency strategy** is closely tied to the economic and energy situation around the world. The influence of world markets on the energy sector, the increased liberalization of trade, the global aspect of several environmental problems of major concern give energy efficiency a special dimension. **Québec's energy efficiency strategy** is therefore part of a common international movement to use energy more productively.

- Certain facts about Québec's economic and energy situation must also be kept in mind. Québec has at its disposal a major asset: it has access to considerable hydroelectric resources, which are only partially managed and developed. The energy sector plays a strategic role in all Québec activities. Moreover, fighting unemployment, improving the well-being of all Quebecers, reducing inequality, all imply that the people as a whole improve their economic situation, which can only be achieved through stronger growth and development.

  Québec's energy efficiency strategy is to use as wisely as possible the various energy sources at our disposal. It must contribute to growth by reducing energy costs of companies. As well, it provides the basis for solid development, the guarantee of a future that meets our expectations and needs.

- One of the keys to the success of **Québec's energy efficiency strategy** lies in the mobilization of all partners when the various measures and actions proposed are put into effect. In the cooperation it outlines, **Québec's energy efficiency strategy** will be based on the structures and mechanisms of existing cooperation. For the gouvernement du Québec, partnership therefore means "pooling" the wills and know-how of all Quebecers to enhance energy efficiency.

C) THEORETICAL POTENTIAL AND THE OBJECTIVE TO ACHIEVE

Québec has made significant energy gains over the past fifteen years. Its **energy efficiency strategy** must help us push further.

- Québec's energy efficiency potential is considerable. It is estimated at nearly a quarter of the total energy consumption recorded in 1990. This potential exists in all demand sectors and includes all energy sources.

  It is, however, theoretical: it supposes concrete behaviour patterns and decisions that are far from certain and which, in most cases, will never be carried out.

- In the short, medium and long terms, all the actions and measures undertaken to use energy more efficiently will help achieve a significant part of the theoretical energy efficiency potential. The government estimates that it should be possible within ten years to transform one-third of Québec's theoretical energy efficiency potential into real energy savings.

  This achievable energy conservation is the quantified objective the government has set in **Québec's energy efficiency strategy**. Reaching this goal will significantly reduce the energy consumption that could be expected without energy conservation. It is therefore estimated that in the year 2001 energy demand will stand at nearly 7% less than the basic forecast without energy conservation.

- The government's quantified objective comprises results in three separate areas:

  — It covers "natural savings," that is, energy conservation that the expected development of technology and consumer habits will achieve within ten years without any special effort on our part.

  — The government's objective also includes the impact of energy efficiency programs set up by Hydro-Québec (programs that will entail investments of 1.9 billion constant dollars — 1991 dollars — by 2000).

  — The quantified objective chosen by the government also includes additional measures and actions proposed by **Québec's energy efficiency strategy**. These are ambitious measures: had they been operational in 1990, they alone would have realized nearly 10% of Québec's theoretical energy efficiency potential available at the time. Whereas the programs set up by Hydro-Québec are aimed at the electricity sector, government measures will concentrate on markets that are not covered by the government-owned utility.

- The objective retained by **Québec's energy efficiency strategy** clearly indicates the magnitude of the endeavour to be undertaken as well as the sectors and areas of activity where this effort will be deployed. The quantification of the objective to achieve is also a tool to see how well the policy adopted by the government is working: to produce the expected results, the measures proposed by **Québec's energy efficiency strategy** must be appraised on an ongoing basis. Having the tools to analyse demand, the government will continually assess the progress of energy conservation and see to what extent government objectives are being achieved. In this sense, determining a precise target for energy efficiency measures is an indispensable means of ensuring its success.

2 MEASURES

Within ten years, the joint action of all Quebecers should help achieve a significant part of the theoretical energy efficiency potential in Québec. This is illustrated by the objective as quantified by **Québec's energy efficiency strategy**: Hydro-Québec's programs and the expected change in the conditions of energy use are complemented by measures and actions taken on government initiative to significantly reduce energy demand as initially projected.

A) FRAMEWORK OF GOVERNMENT ACTION

The energy efficiency measures the government proposes to take are part of an action strategy that must be clearly spelled out:

- This means that the government must *coordinate*, where necessary, the initiatives of the many parties concerned with energy efficiency as well as acquire the tools to *correct* future market shortcomings, should this be required.
- The measures proposed by the government will call for *collaboration* and *group action*, *information* and *public awareness*, *research and development*, *economic and financial incentives*, *laws and regulations*, and *appraisal*.
- In Québec, government measures to coordinate and correct energy efficiency action, which were carried out primarily by the *Bureau de l'efficacité énergétique (BEE)*, have already produced significant results.
- Government action is aimed at an area — that of energy efficiency — where Hydro-Québec has been active for more than a year. *Hydro-Québec's energy efficiency project*, particularly its energy conservation component, represents a major asset in the action program created in Québec to use energy more efficiently.

B) GENERAL MEASURES

Québec's energy efficiency strategy puts forward several major measures that concern all consumers in the residential, commercial, industrial and transportation sectors.

These measures are aimed at making energy users aware of energy efficiency and providing them with certain indispensable means to manage consumption more properly.

These measures do not duplicate existing initiatives. On the contrary, they complete and support them since the government does not intend to take the place of economic agents, whose know-how is critical in improving energy efficiency.

The government therefore proposes measures that include:

- public awareness and information programs;
- support for research and development;
- action in the fields of education, vocational training and proficiency;
- adapting the Programme de productivité énergétique (energy efficiency program);
- setting up a guaranteed investment fund;
- pursuing legislative and regulatory action already initiated;
- the use of the electricity rate structure as a tool of energy efficiency.

C) RESIDENTIAL SECTOR

For the residential sector as a whole, two priority measures — concerning demand management and the "energy rating" of buildings — will be put forth by the government. Complementary actions will be added to these measures.

D) INDUSTRIAL SECTOR

In the industrial sector, the actions proposed will be aimed at two objectives:

- Circulate all the necessary information among big companies as well as small ones;
- Encourage the introduction of new technologies by financing feasibility studies and through aid to demonstration.

E) INSTITUTIONAL AND COMMERCIAL SECTOR

- In this extremely heterogeneous sector, the measures proposed will deal primarily with government and public systems. The potentials to realize are significant, and the public sector must become a true model of energy efficiency.
- Moreover, the cooperation of municipalities and regional county municipalities is strongly encouraged in order to extend the drive for a more efficient use of energy to all municipal networks.
- Along with this priority action, endeavours to raise the public's awareness of energy efficiency will be pursued throughout the commercial sector.

F) TRANSPORTATION SECTOR

The results that will be obtained in the transportation sector will be crucial for **Québec's energy efficiency strategy.**

According to the quantifications worked out, the measures proposed by **Québec's energy efficiency strategy** in the transportation sector alone represent nearly 60% of the impact of all government actions.

These measures are designed to improve the use of energy in the transportation sector in three ways:

— As regards the transportation of people, the government will seek to persuade consumers to *change their behaviour* so as to make greater use of public transportation, and will intervene to *improve the energy efficiency* of all existing motor vehicles in Québec.

— As for the transportation of merchandise, the energy conservation potential of railways should be further developed.

— More general measures — such as the policies of public authorities regarding land use — will have a considerable long-term impact on energy consumption for transportation purposes.

3 FINANCING

The raising of adequate financial resources is required to implement part of the government's energy efficiency measures: the *financing* of these means is therefore a necessary condition of successful government action.

- Since the creation of the BEE in 1977, the gouvernement du Québec has invested more than 100 million dollars to promote and disseminate energy efficiency. For the year 1991-1992 alone, the appropriations allocated to the BEE represented nearly a quarter of the budget of the Energy Sector of the ministère de l'Énergie et des Ressources, or 3.8 million dollars. Over the next few years, the government will strengthen its financial support, the very basis of the financing of **Québec's energy efficiency strategy**.

- The continued financial involvement of the gouvernement du Québec in the promotion and dissemination of energy efficiency is a necessary condition of the success of the measures proposed. However, it would not be logical that the State alone bear the cost of the actions proposed.

  — The various measures proposed by the government to improve energy efficiency will produce benefits for all consumers, individually and collectively. It is therefore normal that these beneficiaries share, at least in part, the financial responsibilities of the measures considered.

  — Energy producers and distributors must also become financially involved in these efforts aimed at greater energy efficiency. We know that this is already the case for the electricity sector, where structures for both cost and rates make investments

earmarked for energy conservation quickly profitable. For energy sources as a whole, the involvement of producers and distributors in a common effort towards greater energy efficiency becomes an increasingly important argument in marketing strategies. We should add that the financial involvement of producers and distributors is often the only way to associate the consumers benefiting from the various measures applied: energy producers and distributors have, in any event, the possibility of integrating their contribution to energy efficiency into their production costs, and therefore to bill energy consumers, the final beneficiaries of the measures thus financed.

- It is imperative that optimal collaboration be assured between these multiple sources of financing. Were this not the case, the implementation of the energy efficiency measures could be accompanied by duplications and overlapping, which might jeopardize the results of the efforts expended.

  Indeed, the financing of the measures proposed by **Québec's energy efficiency strategy** should be a concrete illustration of the partnership and joint action that the government favours.

- Several methods are possible to ensure the coordinated financing of energy efficiency measures: for example, the application of some measures proposed by the government could be assigned directly to the major players concerned — energy producers and distributors — with the BEE assuring a very flexible coordination by supervising the efforts deployed and results obtained. These results could be made public, much like the Bureau de l'inspection et d'information du prix de l'essence (BIPE) does regarding gasoline prices in outlying regions.

- We could further coordinate the financing of **Québec's energy efficiency strategy** by setting up a mechanism to channel private funds to carry out joint projects.

- Other methods are also possible. For example, a nonprofit corporation that would receive government subsidies as well as private contributions could be established; it could be controlled by a Board of Directors that would include representatives of contributing members.

- At any rate, the methods chosen must meet a condition the government deems essential: all the parties concerned must finance the measures proposed by **Québec's energy efficiency strategy**, while the task of the government is to ensure the coordination required and the optimal use of the various sources of financing.

- We have evaluated the cost of the measures proposed in **Québec's energy efficiency strategy**: the actions that require special financing entail, within a given period of time, an annual budget of 10 million dollars. This budget, which is comparable to the cost of similar actions implemented in major industrialized countries, would of course be added to investments made by Hydro-Québec to carry out its own energy efficiency programs.

- To achieve this budgetary objective, several approaches are possible. We must first recall that about a third of this objective is already assured thanks to the appropriations the government grants for energy efficiency through the BEE.

  — We have underscored that consumers, the main beneficiaries of greater energy efficiency, should logically pay part of the costs. Thus, whenever beneficiaries — whether individuals or companies — of a given measure can be identified, the BEE will charge them for at least part of the costs incurred. The BEE will therefore gradually introduce rates for some energy analysis and consulting services it offers its customers in the industrial, institutional and commercial sectors. However, the government will continue to absorb part of the costs, and rates will be adjusted so that their application will not prevent energy efficiency objectives from being attained.

  — The contribution of energy producers and distributors should constitute the other source of funding for the proposed measures. This contribution would be coordinated according to one or the other of the methods mentioned above. In the case of Hydro-Québec, an eventual contribution would be drawn from the funds for the utility's "Projet d'efficacité énergétique" to avoid a double contribution. In general, it is imperative for the government that the contribution of producers and distributors be divided fairly between each energy source concerned, the ideal being that the financial involvement of each interested party be voluntary.

  One or the other of the various methods mentioned should guarantee such an involvement.

  The success of **Québec's energy efficiency strategy** presupposes adequate financing that can be raised in a relatively short time. The government would like the various parties concerned with the energy sector to state the approach they prefer, within the framework just defined. The objective is to enable the government, in collaboration with the interested parties, to channel into the dissemination of energy conservation the financial resources necessary for the success of Québec's strategy as a whole.

4 IMPACTS

The measures proposed by the government in **Québec's energy efficiency strategy** will be in addition to Hydro-Québec's programs and the energy savings achieved through the initiative of Quebecers as a whole; they will also help curtail the growth of energy demand significantly.

This decline in energy demand will have considerable impacts on our economic situation and environmental balance. Several of these impacts can already be identified, even quantified.

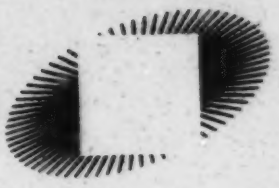
- Employment and economic activity will be stimulated directly by the development of an energy efficiency industry. Over a ten-year period, **Québec's energy efficiency strategy** could entail total investments between 500 and 800 million dollars, creating or supporting from 7,000 to 10,000 jobs in terms of person-years.
- At the "macroeconomic" level, a drop in total energy spending alone would enable Québec consumers to save 1.5 billion dollars (in 1990 dollars) in the year 2001.
- Moreover, the measures analyzed in connection with **Québec's energy efficiency strategy** will immediately affect the energy bills of individuals.
- As a contribution to sustainable development, increased energy efficiency will have multiple impacts on environmental conditions and bring about a significantly improved situation, compared to one without energy conservation. We can already estimate the expected gains in the fight against polluting gas emissions, especially carbon dioxide.

CONCLUSION

Improvement in energy efficiency calls for the continued action of all participants. **Québec's energy efficiency strategy** is basically intended to mark out the road left to travel and clear a certain number of paths to achieve the stated objectives. As its effects will be felt over a long period of time, both the objectives identified and the means to achieve them must be reviewed periodically on the basis of the progress made in the various areas that condition the strategy's implementation.

The role of the State in promoting energy efficiency is to encourage all interested parties to conduct a systematic and regular examination of the situation and to provide a certain number of indispensable common tools. This action is part and parcel of a true partnership between governments, companies and citizens; the objectives to achieve as well as the means to take must therefore be defined jointly.

INTRODUCTION



Québec has already made significant progress in an effort to use its energy sources more efficiently. Since the early 1970s, Quebecers use energy differently, equipment is more efficient, buildings are better insulated. We can already map out the road travelled towards more efficient energy consumption.

Our efforts, however, must not end with the results achieved thus far. Collectively, we can still improve on how we use energy. Indeed, because of the way we normally use energy and the facilities at our disposal, Québec still has an "energy efficiency potential" it can realize, at least in part, by implementing measures and actions applicable within a reasonable period of time. These measures and actions would have a considerable impact on Québec's economic structure, the environment and consumer bills.

Québec's energy efficiency strategy is aimed at supporting and coordinating this common endeavour by answering four questions.

- First of all, *on what potentials for improving energy use can Québec now count on*? This first question is crucial: the determination of the policies proposed and of the targets to aim at depends on an appraisal of our energy efficiency potentials.
- To explore the part of this potential that can realistically be developed within a reasonable time span — that is, within ten years — *what specific actions and measures can we consider*?
- These actions can be carried out only on the condition that they benefit from adequate financial resources. *How can we ensure the financing of energy efficiency measures*?
- Finally, by supposing that the objectives are achieved, *can we already quantify the impacts expected from a more efficient use of energy*?

By providing answers to these four questions, **Québec's energy efficiency strategy** proposes a framework of the actions to be taken. This strategy identifies a number of initiatives that affect all demand sectors and every energy source, and whose concrete expression will help achieve the chosen objectives.

1 OBJECTIVES

A THE OBJECTIVES SOUGHT

In proposing an energy efficiency strategy, the gouvernement du Québec is basically pursuing four goals:

- Strengthen Québec's ***growth and economic development.***
- Improve the situation of ***energy consumers.***
- Protect and respect the environment in view of achieving ***sustainable development.***
- Reinforce Québec's ***security of energy supplies.***

1 ECONOMIC DEVELOPMENT

Québec's energy efficiency strategy is one of economic development. Energy efficiency measures are designed primarily to strengthen Québec's growth and development.

- A more efficient use of energy reduces production costs. It therefore places in a favourable position Québec companies faced with increased international competition. In this spirit, **Québec's energy efficiency strategy** emphasizes measures that are profitable for society as well as for the companies concerned.
- Greater energy efficiency entails the improvement of energy-powered equipment. It therefore translates into major investments with economic spinoffs in the construction, manufacturing, engineering, and service industries.
- Actions aimed at energy efficiency are found, by their very nature, in all of Québec's regions. Their implementation will have a major economic impact in those areas, thus lending support to the regional development objectives pursued by the gouvernement du Québec.
- Energy efficiency constitutes a powerful incentive for technological research and development. Improvement in energy efficiency is linked to the design and adaptation of superior technologies. Efforts aimed at energy efficiency will therefore directly affect electrotechnologies, gas technologies, techniques relating to new materials as well as computer control and management technologies.

2 CONSUMER BENEFITS

Increased energy efficiency benefits consumers. For companies and individuals alike, the goal is to bring consumers to invest and behave so as to cut down their energy bills.

- Energy efficiency helps individuals improve their living standard and contributes to solving often critical problems facing poorer consumers.
- For companies, controlling energy costs means strengthening their ability to compete and the profitability of their operations. The expected energy gains also spur companies to modernize their manufacturing processes.
- For energy consumers as a whole, energy efficiency has very positive direct and indirect effects: it improves the quality of life in the workplace and reduces vulnerability in the face of price fluctuations.

3 ENVIRONMENTAL PROTECTION

The production, transportation and use of energy have diverse and often significant impacts on the environment. *To reduce these impacts, energy efficiency remains the most appropriate, least expensive and easiest means to use.*

- Energy conservation concerns all energy sources; that is why **Québec's energy efficiency strategy** is aimed at all energy uses.
- Each energy source causes its own specific environmental problems and must be dealt with as such. For example, acid precipitations and the "greenhouse effect" are caused by, among other things, fossil fuel

emissions. That is why concern for the environment leads to paying special attention to economic measures regarding these energy sources.

4 SECURITY OF SUPPLIES

The Québec economy imports all its oil and almost all its natural gas. Aside from the effects of such dependence on the balance of trade, access to reliable and permanent fossil fuels is an important dimension of any Québec energy policy.

- Of course, security of supply problems are not as acute now as they once were. The possibility, for Québec, of acquiring its supplies from the western provinces and the end of tensions on the world market have reduced the concerns that dependence on fossil fuels could cause. However, Québec should not drop this concern. It is obvious that for this province a more efficient use of fossil fuels, particularly petroleum products, contributes in the short and long terms to greater security of supplies.
- The concern for security of supplies also affects hydroelectricity. Although hydroelectricity is directly controlled by Québec from production to final distribution, and although it is a renewable energy source, we must take into consideration the necessarily limited nature of the hydroelectric potential that can be developed at relatively low cost and of factors beyond our control, such as runoff.

Overall, and in conjunction with efforts to diversify, it is certain that *energy efficiency is the best strategy to improve Québec's security of energy supplies.*

B CONTEXT OF GOVERNMENT ACTION

Québec's energy efficiency strategy was designed and will be carried out in a context that must be determined.

- This strategy is based on the notion of energy efficiency, a term that should be clearly defined.
- The strategy rests on Québec's current energy efficiency performance, which must be accurately determined.
- **Québec's energy efficiency strategy** is designed to make a direct contribution to "sustainable development," a concept that is worth recalling.
- The proposed strategy is in keeping with the energy and economic situation that affects Québec as well as the world and to which we must at least refer briefly.

- Finally, the success of **Québec's energy efficiency strategy** rests on cooperative and collaborative efforts, therefore on a "partnership," whose content and implications must necessarily be spelled out.

1 THE NOTION OF ENERGY EFFICIENCY

ENERGY CONSERVATION OR ENERGY EFFICIENCY?

Until recently, efforts aimed at rationalizing energy demand and controlling its growth were grouped under the expression "energy conservation." People now prefer to speak of "energy efficiency."

This development in the terms used is not merely a name change. In fact, it corresponds to a broadening of the approach chosen to qualify all actions dealing with energy consumption.

"To conserve energy" means above all to reduce demand and control the use of energy. This notion corresponds well to the concerns of the early 1970s, characterized by the fear of severe shortages in short- and medium-term petroleum supplies.

The more positive expression, "energy efficiency," implicitly links the rational use of energy to the very conditions of growth and development. "Energy efficiency" refers to the principle of growth based on a minimal energy contribution using the most advanced technologies. **Québec's energy efficiency strategy**, as its very name confirms, is based on this principle.

ACTION DEALING PRIMARILY WITH DEMAND

The notion of energy efficiency is aimed ultimately at consumption, but applies to all the links in the energy chain. Energy gains are possible at the production, transportation and distribution stages **"cogeneration"*** being one example. These gains, added to those made at the very instant of consumption, will all contribute to a more efficient use of energy.

The government wanted **Québec's energy efficiency strategy** to deal with demand. This choice does not imply that the government minimizes the importance of actions relating to energy production, transportation and distribution. It also encourages companies in the energy sector to rationalize their operations.

As regards consumption, the dissemination of energy efficiency measures is relatively more complex and delicate. It is heavily dependent on how well informed and aware consumers are, as well as on their financial situation and willingness to invest part of their budget or savings in energy efficiency rather than in other uses.

It appears therefore that the government must deal primarily with consumption, where lack of information and problems of financing prevent economic rationality from having full sway. More precisely, **Québec's energy efficiency strategy** is designed to act on various **"technical factors"*** that explain demand fluctuations: socioeconomic needs, technology, behaviour, or displacement of one energy source by another.

ACTION AIMED AT ECONOMIC EFFICIENCY

The goal of energy efficiency is an economic one. By using energy more efficiently, we aim to increase our national wealth and improve our quality of life. On the level of strict economic rationality, energy efficiency should lead to a smaller energy bill for consumers, companies and society, or from a growth standpoint, to a smaller share of energy in production costs and consumer spending for goods and services.

Québec's energy efficiency strategy favours such an approach. To improve energy efficiency is not enough, it must be applied where it is most profitable for the economy. The notion of economically efficient energy tends to relate energy consumption to the creation of wealth: as for Québec, the aim therefore is for its economy to create more wealth by using proportionately less energy.

2 QUÉBEC'S ENERGY EFFICIENCY PERFORMANCE

Québec is often portrayed as an energy-intensive society, where efforts deployed to make better use of energy resources have not produced the same results as in other countries. Such a statement is unjustified.

INITIAL INDICATIONS

Per-capita energy consumption and energy consumption per thousand dollars of production are the two most common ratios used to measure the **"energy intensity"*** of a country or a community at a given time. They provide at once important indications of a given economy's energy efficiency and an initial comparison in time as well as in space.

For instance, the calculation of per-capita energy consumption recorded in industrial countries since the early 1970s explains the efforts expended to use energy more efficiently in these countries: from 1973 to 1985, per-capita energy consumption fell 11% in all member countries of the Organization for Economic Cooperation and Development (OECD) and 14% in Québec.

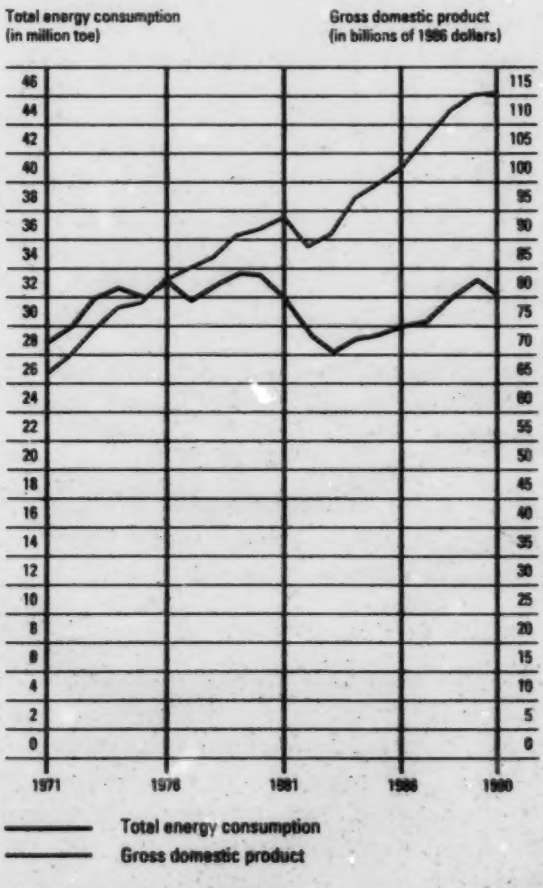
As regards Québec specifically, the analysis of these ratios highlights some major facts.

— If we compare Québec's energy consumption and economic activity, we note that over the past twenty years Québec has produced about 50% of additional wealth with the same quantity of energy (see Graph 1). It is therefore obvious that in 1990 Québec was significantly more energy efficient than it had been in the early 1970s.

— If we compare Québec's situation with that of other regions or industrialized countries, we note that the energy productivity recorded varies significantly from one country to the next. Thus, whether we use the per-capita energy consumption ratio (Graph 2) or that of energy consumption per thousand dollars of production (Graph 3), we see that Québec has performed more efficiently than Canada as a whole, but that it appears less energy efficient than the European Economic Community, Japan and Sweden; comparison with the U.S. yields contradictory results, depending on the ratio used.

Graph 1

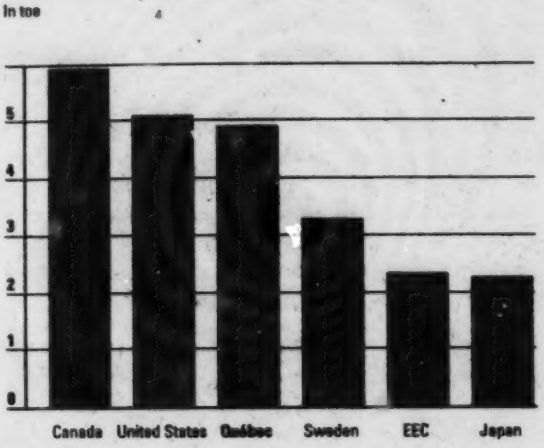
Progress in Québec's energy consumption and economic growth — 1971-1990



Source: *Energy in Québec — 1991 Edition*

Graph 2

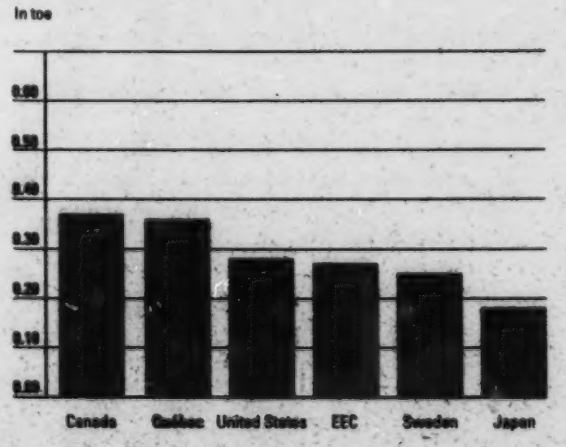
Per-capita energy consumption Québec, Canada and major industrialized countries – 1989



Source: *Energy in Québec — 1991 Edition*

Graph 3

Energy consumption per thousand dollars of output[1] Québec, Canada and major industrialized countries – 1989



1. In 1985 US dollars.
Source: *Energy in Québec — 1991 Edition*

A MORE COMPLETE APPRAISAL OF QUÉBEC'S ENERGY EFFICIENCY: "ENERGY PATHS"

By calculating a society's energy intensity, by appraising it through comparisons conducted in time or in space, we must keep in mind a number of factors that are not directly considered with the ratios we have just used.

In effect, energy intensity and per-capita energy consumption depend on a more or less complex set of conditions and interrelations that characterize the particular situation of every country. The energy intensity of a country or a society depends directly on its climate and geographic situation, the economic structure, the historical development of prices and taxes, national resources, and traditional consumption methods.

Every international comparison must take into account these parameters, which must be adjusted and corrected. For example, over the past fifteen years, Québec has managed to contain the energy intensity of its growth and wealth. These results have been obtained despite Québec's harsh climate and even though Québec, taking advantage of its hydroelectric resources, has developed a relatively more "energy-intensive" economy, compared with other regions of the world.

The concept of "energy paths," illustrated in Graph 4, confirming this and helps us compare over time the efforts deployed by each country to promote energy efficiency and conservation.

By comparing the progress since 1960 in energy intensity, per-capita income and per-capita energy consumption, we note that in most industrialized countries increased per-capita income was accompanied, up to the first oil shock in 1973, by a relatively constant energy contribution per thousand dollars of the gross domestic product (GDP) (approximately 0.70 toe/$1,000 GDP in Canada and in Québec).[1]

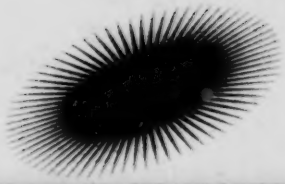
1 toe = tone of oil equivalent (thermal unit of measure used by the OECD).

Since the early 1980s, most countries have managed to simultaneously stabilize per-capita consumption and increase their standard of living by developing a less energy-intensive economy. To achieve this, all had to improve the technical efficiency of their energy consumption significantly. The most spectacular results were achieved by Japan and the U.S., which succeeded better that others to reconvert their national economies, in particular by reducing the share of heavy industry, an energy-intensive sector.

From this standpoint, the results obtained by Québec are quite encouraging. Québec, a region rich in resources, continually improved its energy efficiency performance while pursuing its economic development. Indeed, energy intensity's natural tendency to grow was more than compensated by the gains made in energy efficiency by substituting hydroelectricity for imported oil.

An international comparison of energy efficiency allows us therefore to draw important lessons about how the energy content of economies evolves. However, this comparison must be established with great caution. On the one hand, the ratios used depend on relative economic structures and living standards and should be placed in perspective if we wish to avoid hasty conclusions. On the other hand, the objective of reducing energy intensity, which is quite valid when dealing with imported energy sources, can, for a producer country, prove to be inconsistent with a logical economic development based on comparative advantages in a world economy in full liberalization. The "path" travelled by Sweden since 1980 is a case in point.

In sum — and this is the very basis of the notion of energy efficiency as it is now widely accepted — any energy efficiency policy should no longer be conceived and evaluated solely in terms of thermal units saved, but rather in terms of the economic, ecological and social advantages it provides.



Energy Paths

*The **"energy path"** approach consists in grouping on the same graph three different kinds of information: for each given country, points are drawn representing the progress of energy consumed per thousand dollars of production — the energy intensity of that country — based on the country's wealth measured by per-capita income. The time, or each year for which this ratio between energy intensity and wealth has been recorded, is indicated by the level of each point.*

*The **"energy path"** is the line linking the separate points calculated. This line moves in time through zones indicating per-capita energy consumption. Each zone's boundary is marked by a curve called "isoquant," where the combinations of energy intensity and per-capita income correspond to constant per-capita energy consumption. Where the **"energy path"** moves towards the right, in the direction of the next isoquant, this means that per-capita consumption increases: the growth of wealth did not compensate, it even increased, the impact of the growth of wealth on energy consumption.*

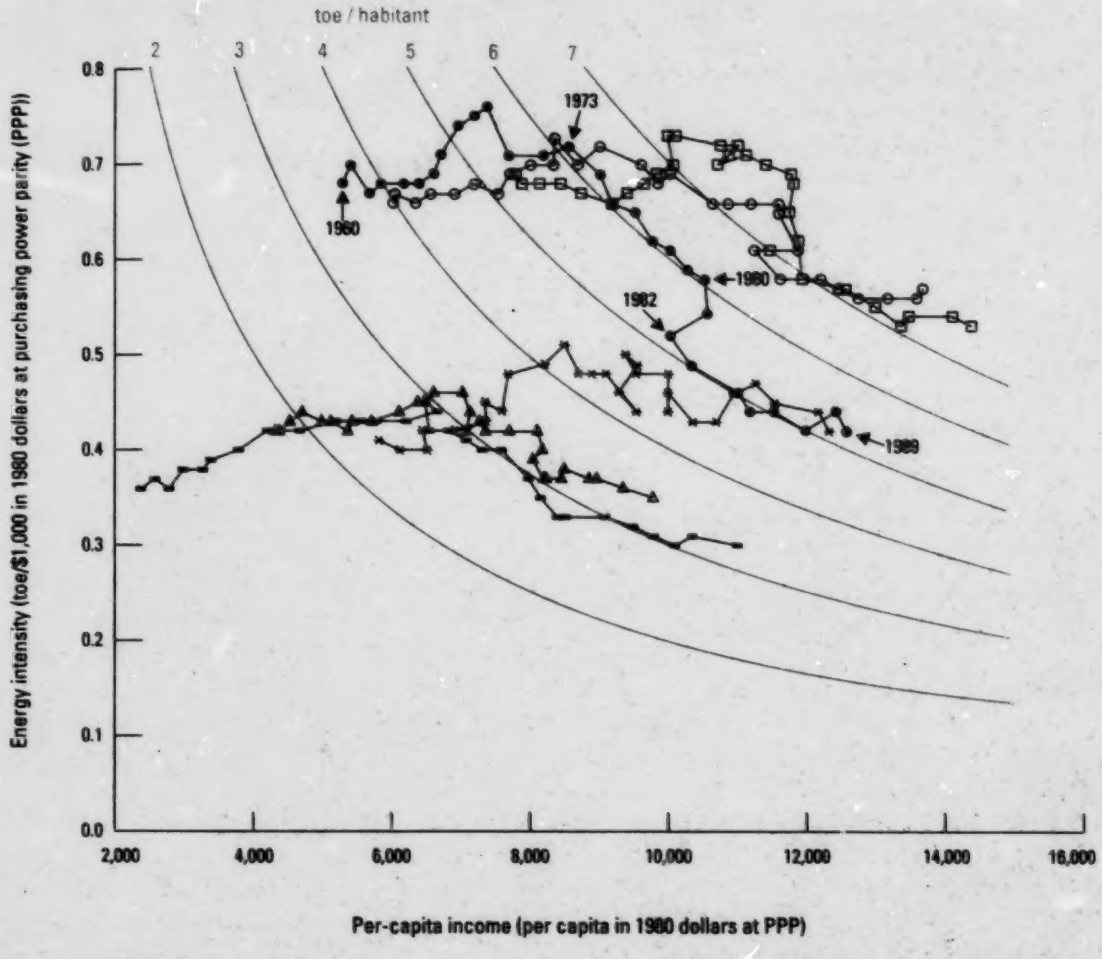
*On Graph 4, we have drawn the **"energy paths"** for Québec and five industrialized societies (Canada, United States, Sweden, Japan, EEC) for the entire period from 1960 to 1989.*

For Québec, the graph illustrates three distinct phases:

- *From 1960 to 1973, energy intensity increased faster than wealth; Québec changed isoquants twice.*
- *From 1973 to 1980, the situation stabilized; Québec remained on the same isoquant.*
- *From 1980 to 1989, Québec's situation improved; energy intensity fell despite the province's increased wealth — which allowed Québec to move towards a lower isoquant, the very same one where Québec was located in the late 1960s.*

Graph 4

Energy paths – Québec and major industrialized countries – 1960-1989



Sources: ENERDATA and ministère de l'Énergie et des Ressources du Québec

Notes:
- toe/$1,000 in 1980 dollars at PPP: ton equivalent of oil per thousand 1980 constant US dollars at purchasing power parity
- 1980 dollars per capita: 1980 constant US dollars per capita at purchasing power parity
- energy data are shown as primary energy, in accordance with the methodology used by the OECD for the purpose of international comparison. These data differ from those in Graphs 1 to 4, particularly as they include transformation losses of electricity produced from thermal sources.
- Isoquants (hyperbolic curves) represent per-capita constant consumption points.

3 SUSTAINABLE DEVELOPMENT

One of the goals pursued by **Québec's Energy Efficiency strategy** is to help protect and respect the environment so as to foster "sustainable development."

- The **notion of sustainable development** was proposed in 1987 by the World Commission on Environment and Development, chaired by Mrs. Gro Harlem Brundtland. In this report,[2] *"sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:*

— *the concept of "needs;" in particular the essential needs of the world's poor, to which overriding priority should be given; and*

— *the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."*[3]

The goal of sustainable development is, therefore, to continually meet people's needs through time, by respecting the limitations of the environment.

- To speak of sustainable development is above all to speak of **development and economic growth**. Indeed, it appears imperative that economic growth be pursued if we wish to meet the needs of growing populations in developed countries as well as developing nations. We must also ensure progressively higher living standards for the poor, especially in developing countries, if we wish to reduce inequalities somewhat. As well, developed countries have not completely met essential needs — such as employment, housing, health — of large segments of their population.

- If satisfying these needs means negative and irreversible ecological impacts, we can assume that the development achieved will not endure. It is therefore critical that governments adopt policies that favour **solutions with less harmful consequences**.

This is true of energy, particularly where economic growth is generated mostly by the use of fossil fuels, a nonrenewable resource. Wherever possible in such cases, this new approach leads us to adopt energy efficiency measures and turn to alternative energy sources such as solar power, wind power, hydroelectricity and biomass. This combination is the only one that can guarantee future generations and developing nations maximum access to nonrenewable resources.

- Moreover, environmental protection for the purpose of sustainable development does not mean we must protect all ecological environments or ecosystems, because no development would then be possible. Instead, it means that an "equivalent" productivity should be maintained overall. It is also important to preserve the productivity of habitats indispensable to the various species of plants and wildlife if we wish to avert the impoverishment of biological diversity.

- The most serious ecological limitations, as well as the most difficult to identify, have to do with **biospheric cycles**.

For instance, acid precipitations are to a great extent the result of human actions on the sulfur and nitrogen cycles. But the capacity of lakes and forests to absorb them is limited. This limitation must be respected if we wish to preserve the use of these resources permanently.

Another biospheric cycle seriously disrupted by human activities is the carbon cycle. Indeed, human activity generates significant amounts of carbon dioxide (CO_2) and methane (CH_4) that exceed the biological environment's capacity to absorb them. The accumulation that ensues in the atmosphere triggers a "greenhouse effect" and leads to gradually warmer temperatures.

2 World Commission on Environment and Development, *Our Common Future*. Oxford University Press, New York, 1987.

3 Op. cit., Chapter 2, page 43.

Although the ecological limitations of these cycles are still not clearly identified, there does exist a scientific consensus recommending the stabilization and even the reduction of emissions. Since energy production and consumption are among the main factors responsible for anthropogenic CO_2 emissions, action aimed at sustainable development entails a reorientation of energy choices based on the relative emissions of the various energy sources.

4 INTERNATIONAL CONTEXT

Québec's energy efficiency strategy is closely tied to the international energy and economic context in three main ways.

- The energy sector constitutes one of the economic activity fields most **influenced by world markets**.

In this sector, oil is the leading energy source, or benchmark, whose prices measure the profitability of other energy sources. This situation is easily explained: despite the impact of the various "oil shocks," oil is still the energy source used most intensively by industrialized countries. In 1985, oil represented 52% of energy demand by member countries of the International Energy Agency. It was forecast that this share would still be 48% in the year 2000. Oil is also an energy source with an irreplaceable flexibility of use and extremely low production costs, which leaves much room for potential price fluctuations.

This is why the oil market is international. Oil prices are determined by trading on world markets and in turn become benchmark energy prices on the various national markets.

This international fact must be borne in mind when preparing any energy policy. **Québec's energy efficiency strategy** is no exception. In Québec, oil is still the leading energy source, although the use of oil has declined considerably over the past twenty years.

It should be added that the influence of world markets on Québec is not restricted to the oil sector. The natural gas market, more regional than the oil market, is increasingly dependent on the North American context. Even electricity, whose markets are traditionally closed because of the production and transportation methods used, is now subject to market conditions outside Québec. The electricity trade between Québec, other Canadian provinces and the northeastern U.S. has significantly increased since the early 1970s, adding a Canadian and international dimension to an activity sector that was formerly limited strictly to the Québec market.

The ripple effect of oil markets on the entire energy sector puts Québec, like all energy-consuming countries, face to face with a reality that is difficult to circumvent, that of the security of oil supplies.

Few experts today would agree with the alarmist assessments that, in the early 1970s, indicated crude oil shortages. Conversely, at the geopolitical level, the oil market situation has progressed little. Crude oil production remains more than ever concentrated in a small number of countries in a politically volatile region, which makes international oil supplies quite sensitive to the uncertain conditions prevailing in the area. The relative dependability of oil supplies therefore affects the international energy situation specifically and is one of its main characteristics.

- **Québec's energy efficiency strategy** is linked to the international context in another way, by the **development of trade relations among countries and regions**.

Having learned the lessons of "the great depression" of 1929, industrialized countries made the firm commitment immediately following World War II to liberalize trade. The economic slowdowns or the recessions that we have experienced in the past forty years did not therefore lead to custom or tariff "wars," as was the case in the early 1930s.

However, for the past ten years, the development of international trade relations has entered a new phase marked by the accelerated liberalization of multilateral

trade and by the creation or strengthening of integrated economic zones.

The work accomplished under the General Agreement on Tariffs and Trade (GATT) has led countries from the North as well as from the South to bring down some of the barriers to international trade and open their markets to foreign imports, thus forcing them to become even more active on foreign markets.

Along with liberalized international trade relations, the successes of the European Community have prompted the creation or strengthening of major economic zones with unparalleled economic integration. The signing of the Single European Act by the Europeans will therefore considerably influence intra-European trade and economic relations, beginning in 1992. In North America, the Canada-U.S. Free Trade Agreement and its projected extension to Mexico correspond to this integration movement within regional economic zones.

The liberalization of international trade and the forging of integrated economic zones are imposing new demands on the economies concerned, the first of which is, of course, competitiveness. That is why energy efficiency is arousing new interest and becoming more important.

Subject to international economic constraint, **Québec's energy efficiency strategy** provides Québec with a means of meeting international economic challenges. To assure and strengthen the competitiveness of companies and economic agents, the promotion of energy efficiency must not increase the burdens of producers of goods and services. Quite the opposite, **Québec's energy efficiency strategy** must be designed as a privileged means to reduce the energy costs of Québec's economy so as to improve our ability to compete on international markets.

- There is a third international dimension to **Québec's energy efficiency strategy**, the one ensuing from **environmental matters**. We mentioned above the harm done to the environment by all energy-related activities. However, several of these disruptions can be assessed, analysed and corrected only through a general and global approach. This is true of situations relating to the warming of the atmosphere, the destruction of the ozone layer and the emission of acid precipitations.

It is precisely because of the global nature of the problem that a growing number of international agreements are being signed to coordinate efforts that cannot be defined separately. In this connection, we should mention the Montréal Protocol on Substances that Deplete the Ozone Layer, the Agreement between the Government of Canada and the Government of the United States of America on Air Quality and, more recently, efforts undertaken under the aegis of the United Nations to limit gas emissions causing a greenhouse effect, efforts that should be on the agenda at the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992.

Québec's energy efficiency strategy contributes to this international cooperation aimed at restoring the seriously threatened global environmental equilibrium. Even if Québec has already significantly progressed in controlling the impacts of its energy-related activities at several levels, it must pursue its effort. **Québec's energy efficiency strategy** is part of this common international movement.

5 QUEBEC CONTEXT

Using especially the concept of "energy path," we illustrated in the preceding pages several characteristics of Québec's energy and economic situation.[4] Three facts stand out.

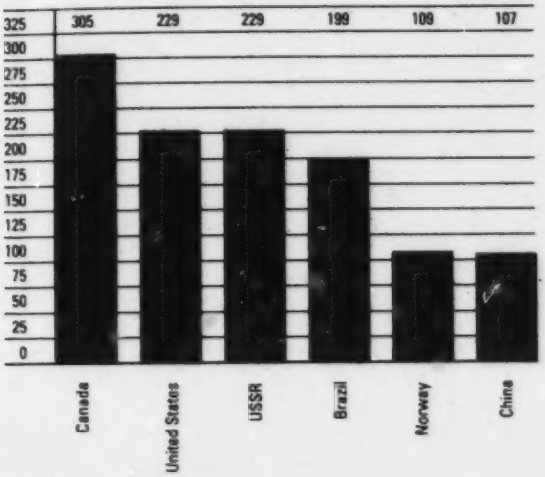
- As regards energy proper, Québec has available a major asset: access to **abundant hydroelectric resources**, which are only partially developed.

4 See above, p. 18 ff.

Graph 5

Major hydroelectric producer countries in the world – 1988

In billion kWh

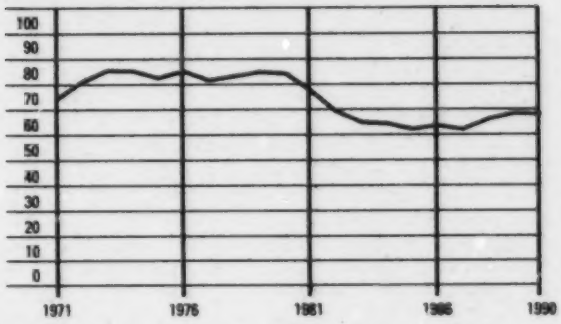


Source: *Energy in Québec — 1991 Edition*

Graph 6

Carbon dioxide emissions in Québec[1] – 1971-1990

In million tons



1. Includes biomass and consumption by refineries, but excludes thermal generating stations.

N.B. CO_2 emissions for 1971 do not include those from biomass consumption in the industrial sector.

Source: *Energy in Québec — 1991 Edition*

The fourth ranking hydroelectricity producer in the world, Québec has the privilege of benefiting from an alternative energy source whose development causes no greenhouse effect, acid precipitations or ozone emissions in urban areas. Quite the opposite, by replacing fossil fuels on some markets, hydroelectricity reduces environmental damage caused by other energy sources.

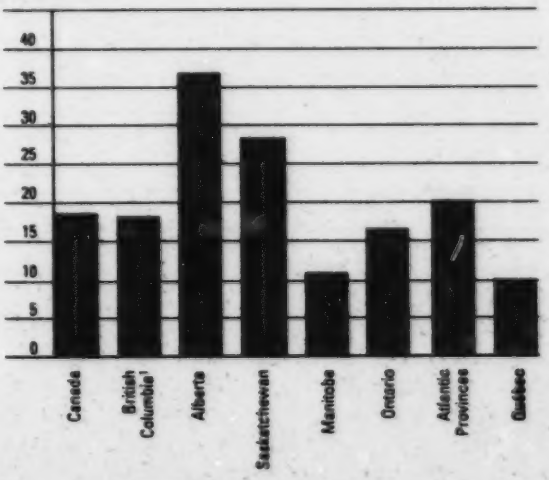
By doubling the share of electricity in its energy mix, Québec has therefore made a significant contribution to environmental protection over the past twenty years. It is estimated that carbon dioxide emissions in Québec fell 20.3% between 1973 and 1990. These were the lowest per-capita emissions in Canada in 1989 and less than half the emissions recorded in the U.S.

This fact leads to a first observation: our relative advantage due to hydroelectricity should be used to fullest advantage. This means that Québec must use its abundant hydroelectric resources in the wisest possible way. **Québec's energy efficiency strategy** is aimed precisely at making the best possible use of this asset.

Graph 7

Per-capita carbon dioxide emissions Québec and other Canadian provinces – 1989

In tons



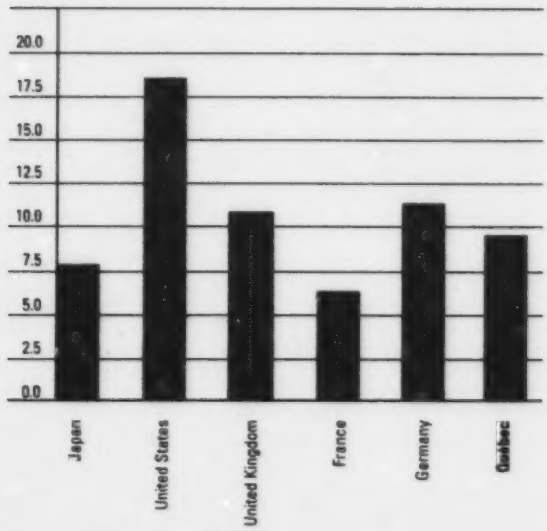
1. Also includes the Yukon and the Northwest Territories.

Source: *Energy in Québec — 1991 Edition*

Graph 8

Per-capita carbon dioxide emissions Québec and major industrialized countries – 1986

In tons

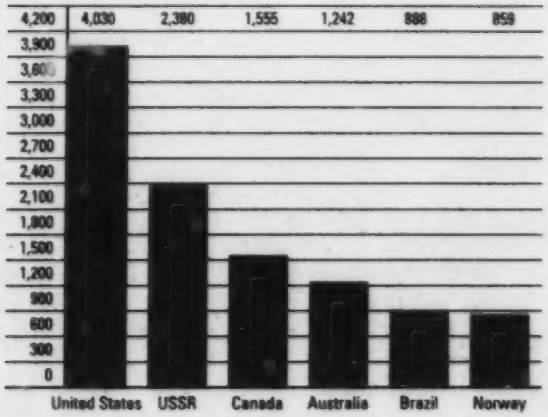


Source: *Energy in Québec — 1991 Edition*

Graph 9

Major aluminium producer countries[1] in the world – 1989

In thousand tons



1. Primary aluminium.

Source: *Energy in Québec — 1991 Edition*

- A second, economic fact must be underscored. The energy sector plays a **strategic role in all of Québec's activities**. Indeed, Québec owes part of its growth to energy, particularly to the low-cost availability of abundant hydroelectric resources.

A significant part of the investments from Québec's economy as a whole has gone towards the development of these resources. Entire sectors of our economy have been set up and developed because available Québec energy was assured them. These energy-intensive industries form the basis of regional economic development and are among our major exporters.

Québec owes these industries its often enviable position in international trade. For instance, after the U.S. and the former Soviet Union, Québec is currently the world's third ranking aluminium producer, and its leading exporter.

These industries are by definition energy intensive. An energy efficiency strategy that would aim at limiting their growth would deprive Québec of one of the driving forces of its development. Moreover, the displacement of these activities to other regions of the world would mean that most often Québec hydroelectricity would be replaced by energy sources that are much more harmful to the environment.

Québec's energy efficiency strategy is not in any way aimed at diminishing the role of energy in the economy. On the contrary, its purpose is to consolidate Québec's economy by encouraging energy-intensive industries to reduce their energy costs. Greater demand-control will have a particularly important effect on the production costs of industries for which energy is precisely a major factor.

- A third fact charactorizes Québec's economic context: the fight against unemployment, improving the well-being of all its people, and reducing inequalities all imply higher living standards for the people, which can only be achieved through **stronger growth and development.**

When we examined the notion of "sustainable development," we made the following point: the needs that the planet must meet imply and justify the very principle of development. What is true on a global scale is also true within our own society. Without strong economic growth, Québec cannot find a solution to the challenges it must face. It would be illusory to think we can ensure regional development and offer jobs to future generations while limiting economic growth, by whatever means.

Québec's energy efficiency strategy cannot therefore be part of a "zero-growth" policy. On the contrary, by developing energy conservation potentials, the gouvernement du Québec aims to reinforce our production system and lay the foundation to strong development, the guarantee of a future that meets our expectations and requirements.

6. PARTNERSHIP

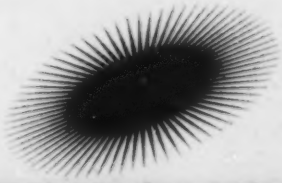
One of the keys to the success of **Québec's energy efficiency strategy** is the partnership the government wishes to form in order to implement the various measures and actions proposed.

- This offer of partnership stems from an obvious fact: energy-related activities involve a considerable number of players, make use of all types of technologies, require all sorts of operations. Each energy source has its own special techniques and particular industrial structure.

This diversity is not limited exclusively to the field of energy production, transportation and distribution. Energy efficiency regards energy consumers, in practice all of society's economic agents. A more productive use of energy concerns individuals and companies alike.

Some partners are especially valuable. Manufacturers and installers of the equipment used to process energy into heat or work, professional associations, groups of companies, all must advise their customers or members on the energy-related decisions the latter must make. On this score, they are privileged players in any action aimed at improving energy efficiency.

- The gouvernement du Québec **considers crucial the contribution and cooperation of all**. To speak of partnership clearly indicates what forms of participation will be favoured. True cooperation must be established at all levels between the various parties involved in order to make better use of energy. For instance, this means that producers, distributors and consumers must exchange and share available data



Association québécoise pour la maîtrise de l'énergie (AQME)

*The **Association québécoise pour la maîtrise de l'énergie (AQME)**, founded in 1985 with the backing of the gouvernement du Québec, brings together more than 600 specialists in energy-related matters. Working in the private, public and parapublic sectors, members of the **AQME** share the same interest in mastering energy, defined as the effective control and management — in harmony with the environment — of the development, production, transportation, distribution, use and recovery of all conventional and alternative energy sources. The **AQME** is therefore basically concerned with energy efficiency and the consequences of energy consumption on the environment.*

*The AQME emphasizes communication: publication of a journal and bulletin, organization of congresses and conferences, publication of technical guides and directories, participation in hearings organized by governments as well as companies in the energy sector. The purpose of these actions is to inform and raise the awareness of managers in favour of energy efficiency, to disseminate information about new technologies, and improve the training of the specialists concerned. Moreover, the **AQME** organizes certain activities at the international level, especially among French-speaking countries.*

with the government, organize joint information and public awareness campaigns, prepare common endeavours, and reflect together about applying possible standards or required regulations. This also means that local and regional authorities, as well as the various government agencies and departments concerned, must collaborate and help influence the energy choices of consumers.

- The government is aware of the challenge that the creation of a partnership in the field of energy presents.

In the oil sector, the competition in which the companies are involved requires a special approach. Partnership cannot have the same meaning in the electricity sector, where basic activities are ensured by a government-owned public corporation, as in the natural gas or oil sectors, where private companies of all sizes, national as well as foreign-owned, operate.

The cost structures of the various companies in the energy sector must also be considered. These structures have a direct bearing on the economic calculation that companies use to define their effort to promote energy efficiency. The notion of **"avoided cost"*** helps us understand the various existing situations. Partnership cannot therefore have the same meaning for each company involved in the energy sector.

- In the collaboration it proposes, **Québec's energy efficiency strategy** takes into account these diverse concrete situations. It will be based on existing group structures and mechanisms, among which the most important is the Association québécoise pour la maîtrise de l'énergie (Québec association for energy conservation and efficiency). Energy efficiency is the raison d'être of the AQME, and partnership its preferred mode of operation. For this proven agency, the implementation of **Québec's energy efficiency strategy** will mean greater responsibilities and increased involvement.

Overall, the measures proposed in **Québec's energy efficiency strategy** entail a wide range of actions and interventions. They will be carried out successfully only through the cooperation of all concerned. For the gouvernement du Québec, partnership therefore means the "pooling" of wills and know-how of all Quebecers to promote a more efficient use of energy.

C THEORETICAL POTENTIAL AND THE OBJECTIVE TO ACHIEVE

Québec has made significant energy gains over the past fifteen years. Its **energy efficiency strategy** must enable it to push further.

To define a quantified objective and determine the measures to apply, we must first appraise *Québec's theoretical potential in energy efficiency.*

All the actions undertaken or proposed in view of using energy more efficiently would realize part of this potential, which is the *quantified objective* proposed by **Québec's energy efficiency strategy.**

1. THEORETICAL ENERGY EFFICIENCY POTENTIAL

The question asked is a simple one: what energy efficiency possibilities does Québec's economy have? To answer this question, we must quantify the **"theoretical energy efficiency potential."*** We are therefore seeking to spell out the share of energy consumption that could be saved if certain changes were made in the way we use energy. Several of these modifications will come about either naturally or as a result of various actions. Others will never take place, which, precisely, explains the theoretical nature of the potential identified.

FRAMEWORK OF ANALYSIS

To define an energy efficiency potential, we must first agree on the type of actions and changes that will be considered in energy consumption.

In the quantification presented here, we have retained a number of definitions that allow us to specify the nature of the theoretical energy efficiency potential. In the residential, industrial and commercial sectors, technical and economic considerations are the sole criterion used to appraise this potential. In the transportation sector, where this rule would be difficult to apply, we proceeded by scenarios.

Overall, we have tried to define this theoretical potential as broadly as possible by not quantifying measures or actions considered controversial (that is, which entail a loss in the well-being of consumers in the residential and commercial sectors; that are unprofitable over the service life of equipment; etc.).

RESULTS ACHIEVED

— Québec's theoretical energy efficiency potential is quite significant. It is estimated at almost a quarter of the total energy consumption recorded in 1990. This means that, if all the changes identified in the ways Quebecers use energy had actually been made, Québec's energy consumption in 1990 would have stood at 24.9 Mtoe[5] or 1,044 PJ,[6] instead of the 32.2 Mtoe or 1,348 PJ actually recorded.

— This potential concerns all demand sectors and energy sources.

— As regards demand sectors (see Graph 11), two-fifths of the theoretical energy efficiency potential are in the industrial sector. The residential and transportation sectors each represent nearly a quarter of the theoretical energy efficiency potential (respectively 23% and 23.8%). Finally, 12.1% of the potential identified originates in the commercial and institutional sector.

— Breakdown by energy source (see Graph 12) shows that nearly half of the theoretical energy efficiency potential is in the oil sector (46.5%), slightly less than a third in the electricity sector (31.2%), and the remaining potential in the natural gas sector (22.3%).

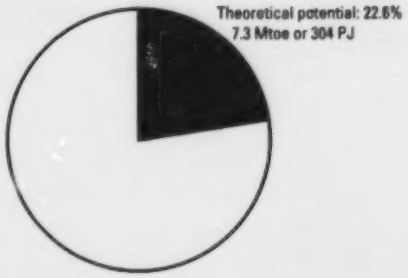
— This breakdown of the theoretical potential by demand sector and by energy source corresponds as a rule to that of total energy consumption by source and by sector.

5 Mtoe: million tonne in oil equivalent (unit of thermal measure used by the OECD).

6 PJ: petajoule (unit of thermal measure used in Canada).

Graph 10

Québec's theoretical energy efficiency potential – 1990

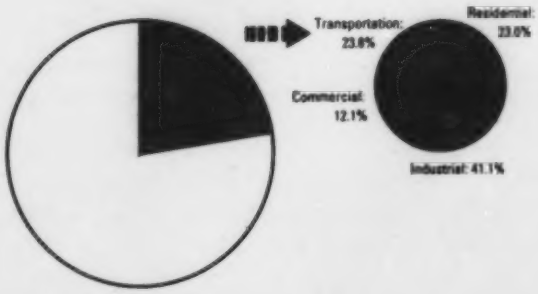


Total consumption: 32.2 Mtoe or 1,348 PJ

Source: Ministère de l'Énergie et des Ressources du Québec

Graph 11

Québec's theoretical energy efficiency potential – 1990
Breakdown by demand sector

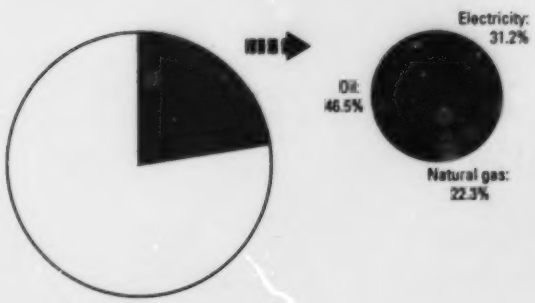


Total theoretical potential: 7.3 Mtoe or 304 PJ, had this potential been applied to energy consumption in 1990.

Source: Ministère de l'Énergie et des Ressources du Québec

Graph 12

Québec's theoretical energy efficiency potential – 1990
Breakdown by energy source



Total theoretical potential: 7.3 Mtoe or 304 PJ, had this potential been applied to energy consumption in 1990.

Source: Ministère de l'Énergie et des Ressources du Québec

— With respect to consumption sectors, we note that in the transportation sector the potential identified is somewhat less than the general average.

— Regarding energy sources, we should mention that the theoretical energy efficiency potential is proportionately higher in the oil and especially gas sectors than for electricity.

In the electricity sector, the theoretical energy efficiency potential identified (2.3 Mtoe or 95 PJ, or 26.4 TWh) corresponds almost exactly to the action potential evaluated by Hydro-Québec. The only differences that arise concern markets that produce their own power, which Hydro-Québec does not serve, and the potential that should be achieved without the utility's intervention. Hydro-Québec has in addition included in its calculation of potential certain "new requirements," not included in the appraisal presented here for 1990.

THE THEORETICAL NATURE OF THE IDENTIFIED ENERGY EFFICIENCY POTENTIAL

This existing energy efficiency potential is considerable. But we must point out that it is also theoretical, basically for two reasons.

— In the residential, commercial and industrial sectors, the potential identified corresponds to the perfectly rational economic behaviour of all the producing and consuming agents who would thus make all their decisions based on the calculation of the service life of the equipment.

In fact, we know that several obstacles slow the progress of most measures designed to save energy. Lack of information, limited access to financing, the fact that in energy matters the consumer is not always the one who decides, and uncertainty about future energy prices are some of the barriers that delay or even impede the progress of energy efficiency.

One obstacle is particularly serious. When energy consumers calculate the cost of energy efficiency measures, most of them insist on extremely short periods of time to recover their investments, considerably less time than the service life of the equipment. However, it is estimated that, depending on the market, energy savings that prove profitable in less than two years represent only 10% to 30% of the total theoretical potential. Moreover — and this situation is still more disturbing — even these energy savings are far from certain. Many customers actually refuse to have anything to do with measures that do not cost anything but still increase energy efficiency immediately; for example, turning the temperature down manually for the night.

It is therefore obvious that identifying the theoretical potential for the customer is no guarantee that the energy savings quantified will indeed be achieved.

— In the transportation sector, where the field of analysis is somewhat different, the scenarios prepared included major changes in the use of energy for travelling.

Here again, and perhaps even more than in other demand sectors, the theoretical energy efficiency potential supposes decisions and behaviour changes that in practice are far from certain.

2. ENERGY EFFICIENCY OBJECTIVE TO ACHIEVE

In the near, medium and long terms, all the actions and measures taken to use energy more efficiently will help achieve an important part of the theoretical energy efficiency potential that has just been quantified. Based on as accurate a quantification as possible, the government estimates that we could, within ten years, transform into actual energy savings a third of the theoretical potential currently identified in Québec.

For instance, this means that in 1990 this potential for energy conservation would have indeed helped reduce energy demand by 2.5 Mtoe or 103 PJ of a quantified theoretical potential totalling 7.3 Mtoe or 304 PJ.

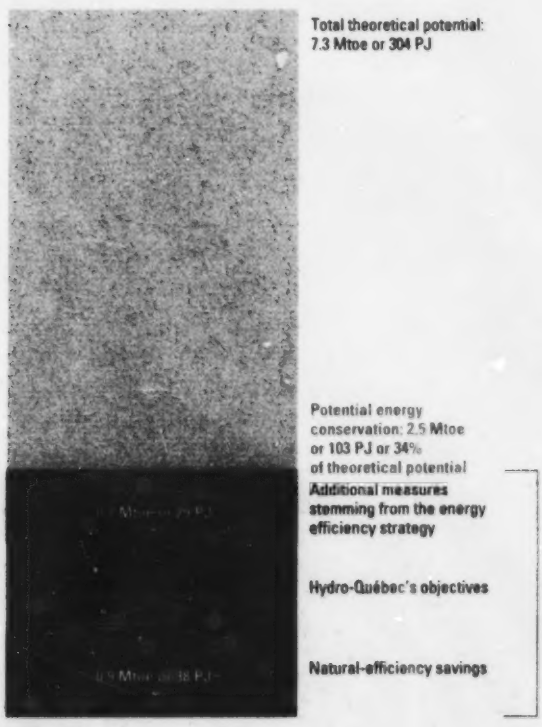
This potential for energy conservation is the quantified objective the government has retained in **Québec's energy efficiency strategy**. Achieving this objective will significantly reduce energy demand as forecast without energy conservation. We therefore observe that the annual average growth rate for overall energy demand would be reduced by 35% by 2001 (see Graph 14), dropping from 1.7% to 1.1% (percentages calculated for the period from 1988 to 2001). This means that in 2001 energy demand would stand at 40.2 Mtoe or 1,681 PJ, or drop nearly 7% compared to the basic forecast without energy conservation.

- The government's quantified objective includes the effects of three kinds of factors.

  — First, this objective includes all "natural savings," namely, the theoretical energy efficiency potential that the expected development of technology and consumer habits will help achieve within ten years. These natural savings include, for example, the impact of improvements (that should occur during this period) to the energy efficiency of motor vehicles, or the measures that economic agents will themselves apply.

Graph 13

Energy efficiency objective to achieve in Québec: what we could have saved in 1990


Total theoretical potential: 7.3 Mtoe or 304 PJ
Potential energy conservation: 2.5 Mtoe or 103 PJ or 34% of theoretical potential
Additional measures stemming from the energy efficiency strategy
Hydro-Québec's objectives
Natural-efficiency savings

1. 0.85 Mtoe.

Source: Ministère de l'Énergie et des Ressources du Québec

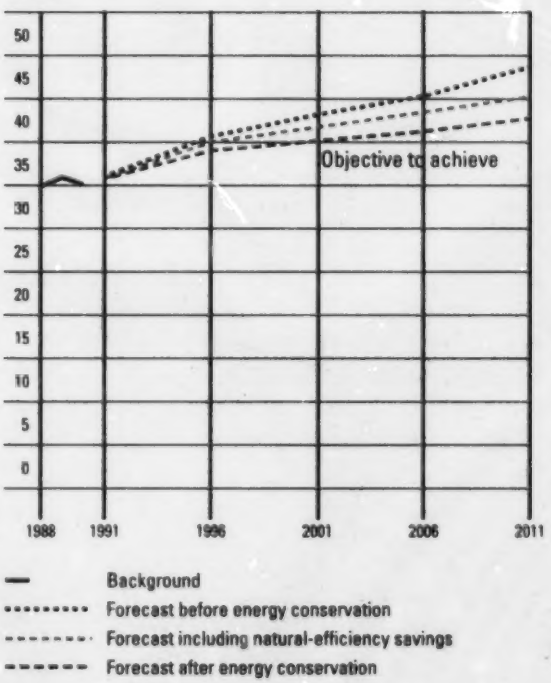
This is an example of the amount of energy saved through natural efficiency: it was estimated that this quantity alone would have realized in 1990 the equivalent of 12% of the theoretical energy efficiency potential. The impact of these natural savings increases with time because of the ever wider dissemination of new technologies when replacing used or obsolete equipment.

— Second, the government's objective includes the impact of energy efficiency programs set up by Hydro-Québec. We know that since 1990, Hydro-Québec has introduced a wide-ranging energy conservation program aimed at the utility's customers. To carry out this program, Hydro-Québec plans to invest, by the year 2000, 1.9 billion constant

Graph 14

Québec's energy demand – 1988-2011

In Mtoe



Source: Ministère de l'Énergie et des Ressources du Québec

dollars (1991 dollars). According to Hydro-Québec's own assessments, in 2000 this program will have saved 9.3 TWh of electricity (9.9 TWh in 2001), or the equivalent of slightly more than 35% of the theoretical energy efficiency potential in the electricity sector in 1990.

— Third, the quantified objective selected by the government includes the additional measures and actions proposed by **Québec's energy efficiency strategy**, whose content is found in the following section.

These are ambitious measures. In 1990, they alone would have reduced energy consumption by 0.7 Mtoe or 29 PJ, or nearly 10% of Québec's total theoretical energy efficiency potential for that year. Whereas the programs set up by Hydro-Québec are aimed at the electricity sector, government measures will focus on markets not covered by the government corporation.

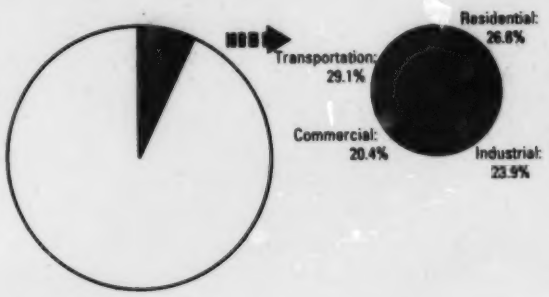
To avoid duplication in quantifying, the impact of several government actions on the electricity sector will not be taken into account here since these measures have been considered at least in part by the utility in its own quantification calculations.

- In addition to natural savings and Hydro-Québec's programs, the actions proposed by **Québec's energy efficiency strategy** will significantly modify energy demand for the next twenty years.

  — For the time chosen to complete all actions and changes, that is, in 2001, the energy efficiency objective retained by the government will help reduce energy consumption in various demand sectors to 40.2 Mtoe (1,681 PJ) in absolute value, compared to 43.2 Mtoe (1,807 PJ), which this consumption would have reached without energy conservation. With respect to energy sources, demand would be reduced by 7.5% in the oil sector, 7.4% in the electricity sector and 7.8% for natural gas.

Graph 15

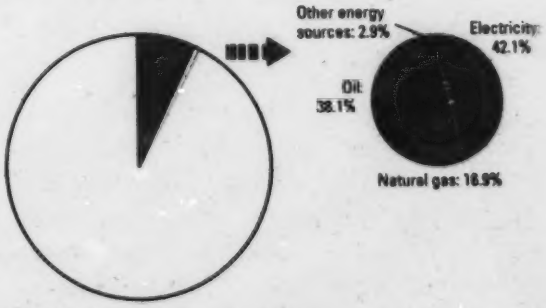
Energy efficiency objective to achieve in Québec – 2001
Breakdown by consumption sector



Source: Ministère de l'Énergie et des Ressources du Québec

Graph 16

Energy efficiency objective to achieve in Québec – 2001
Breakdown by energy source



Source: Ministère de l'Énergie et des Ressources du Québec

— In absolute value, a significant part (see Graph 16) of the quantified energy efficiency objective will be achieved in the electricity sector. This is not surprising. Among all the power distributors operating in Québec, Hydro-Québec is unquestionably the leader in energy efficiency. In addition to natural savings, the energy efficiency programs set up by Hydro-Québec will produce their full effect in 2001 and will help reduce electricity demand significantly, as compared with forecasts without energy conservation.

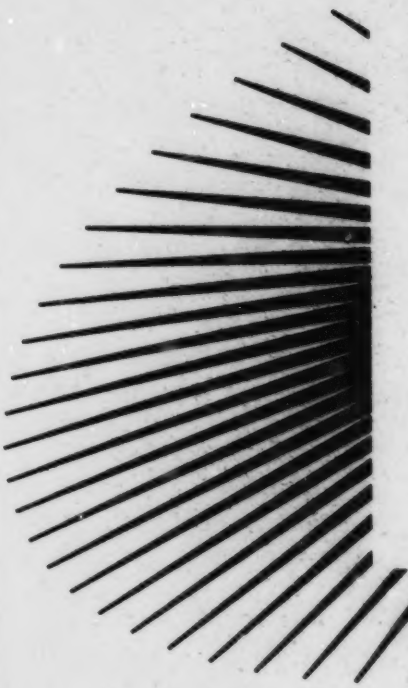
— In the oil sector, the quantified objective of **Québec's energy efficiency strategy** means, in effect, almost zero growth in Québec's oil demand for the period from 1988 to 2001. The results obtained here will be attributable basically to energy conservation measures proposed by the government and to natural savings.

— In the natural gas sector, the quantified objective calls for a 7% reduction in natural gas consumption in 2001, compared with forecasts without energy conservation. The growth rate of final demand for natural gas for the 1988-2001 period would therefore decline by one-fourth and stand at about 2%.

— A sound understanding of the quantification performed requires two additional clarifications. First, comparisons between forecasts including energy conservation and forecasts not including energy conservation are made using a scenario called **"frozen efficiency,"*** which excludes the greater part of natural savings.

Second, it was impossible to quantify the impact of the various actions and appraisals for all the measures proposed by **Québec's energy efficiency strategy**. Some measures, such as support for research and development, play an essential role in preparing and disseminating energy-efficient technologies. However, attributing specific reductions in energy demand to these measures would have presupposed appraisals that are too approximate and do not correspond to the spirit of the quantification calculations.

The objective retained by **Québec's energy efficiency strategy** is a clear indication of the magnitude of the effort undertaken and the sectors and fields of activity where this effort will be deployed. This quantification of the objective to achieve must also be an instrument to monitor the policy put forward by the government. The measures proposed by **Québec's energy efficiency strategy**, to have the effects hoped for, must be periodically reappraised. Thanks to the tools at its disposal to analyze demand, the government will continually appraise the dissemination of energy conservation and the implementation of the objectives retained. In this way, defining a specific target for energy efficiency action is an indispensable means of ensuring its success.



2 MEASURES

A FRAMEWORK OF GOVERNMENT ACTION

Within ten years, the combined action of all Quebecers should achieve a considerable part of Québec's theoretical energy efficiency potential. Government measures and actions to significantly reduce energy demand as initially projected complement Hydro-Québec's programs and the expected progress in the conditions of energy use.

The energy efficiency measures the government plans to implement are part of an action program that must be clearly defined.

- The government's task is to *coordinate*, whenever necessary, the initiatives of the large number of parties concerned with energy efficiency and acquire the tools to *correct* eventual market imperfections, should this be required.
- The measures proposed by the government to encourage and promote the best possible dissemination of energy efficiency will call for *collaboration* and *group action*, *information* and *public awareness*, *research and development*, *economic and financial incentives*, *laws and regulations*, and *appraisal*.
- In Québec, the government's task of coordinating and correcting energy efficiency matters has already yielded significant results. It has relied and will continue to rely above all on the *Bureau de l'efficacité énergétique* (BEE).
- The government measures are aimed at an area where Hydro-Québec has been waging a vast campaign for more than a year. *Hydro-Québec's energy efficiency project*, especially its energy conservation component, represents a major asset in Québec's endeavour to use energy more efficiently.

1 ROLE OF THE STATE IN ENERGY EFFICIENCY

Developing some of the theoretical energy efficiency potential depends on a great many choices that relate to equipment and behaviour; these choices are made by all energy consumers according to needs, technologies and prices, all of which can change rapidly.

THE STATE MUST COORDINATE

There are all kinds of initiatives whose goal is to promote energy efficiency: initiatives of producers and distributors with different means and priorities; initiatives of energy-intensive industries for which cutting the energy bill is a crucial element of the ability to compete on markets; initiatives of all individuals and organizations involved in the final decision to consume energy: manufacturers' associations, professional groups of equipment installers and, of course, individual consumers.

All these initiatives aim at the same objective and must therefore be encouraged by the government. But they must also be *coordinated*. It is indeed imperative that we avoid duplication or contradictions that could hamper or even jeopardize the actions taken. Coordination is, of course, the task of the government, which can count on existing channels to accomplish this work.

THE STATE MUST CORRECT

From the vantage point of society, energy efficiency is not always given the priority it deserves, in particular because of imperfect price and market mechanisms. This difficulty is obvious when we examine the concept of **"avoided cost."***

Of still greater concern is that energy consumers do not always display rational behaviour — far from it. Through lack of information and public awareness, they often make energy-related choices that run counter to their own interest.

In cooperation with its partners, the government must seek to *remedy* these weaknesses and shortcomings whenever it is able to do so with the means at its disposal.

2 NATURE OF GOVERNMENT ACTIONS

COLLABORATION AND GROUP ACTION

Because of the number and diversity of parties involved, an energy efficiency strategy must rest primarily on the genuine cooperation of all the players on the energy market.

— It is from energy distributors and producers as well as equipment manufacturers that consumers will receive the information required to make wise decisions.

— These same consumers, whether individuals or company administrators, must feel responsible and take part in determining the objectives to attain and the means to apply in the areas that concern them.

— Experts, consultants and researchers must also be mobilized directly or through the professional associations that bring them together and advise them.

The role of the government is to foster this cooperation and group action.

INFORMATION AND PUBLIC AWARENESS

— Progress in energy efficiency presupposes that consumers are informed and made aware of the various methods and means available for a more productive use of energy. This information and public awareness are assured largely by energy producers and distributors, equipment manufacturers as well as specialist and user associations. The role of government is to support these initiatives and take up the slack when they seem to be insufficient.

— The government can provide a source of other — and sometimes more neutral — information to confirm or correct the information circulated.

— The training of the people involved and the dissemination of technologies through support for development and demonstration projects are other means of informing and raising public awareness.

— Besides information, personalized help in decision making offers various consumer groups opinions and advice in the choice of technologies and processes that are adapted to their needs as well as technically and economically efficient.

Government action is justified on this score by the need to overcome initial resistance and is based on the fact that these programs are highly profitable for society.

RESEARCH AND DEVELOPMENT

— To promote long-term energy efficiency presupposes research and development efforts in the various technologies concerned.

— We are speaking here of research and development in a broad sense, namely, a true development of knowledge that also includes standards that would eventually apply to energy production and consumption.

In Québec, laboratories, research centres, private and public organizations as well as associations contribute to this research and development effort in energy efficiency. The government's role is to promote, encourage and support these activities by providing personnel and financial assistance.

ECONOMIC AND FINANCIAL INCENTIVES

— Setting prices and rates that reflect the true value of the energy consumed is the best way to give direction to consumers and producers. However, prices and rates do not necessarily incorporate all the social costs associated with energy production and consumption.

— It might be necessary to consider economic and financial incentive programs to bring down certain barriers that prevent the dissemination of new

technologies. The government will therefore intervene to remove financial constraints, reduce initial high costs or even improve on the economic calculations performed on the basis of current costs.

LAWS AND REGULATIONS

Laws and regulations are the special instruments of government action. With respect to energy efficiency, laws and regulations must be applied to ensure that consumers benefit from standards guaranteeing a minimum of quality, to modify some of society's modes of operation and to act in a lasting way on behaviour considered reprehensible.

Permanent government action gives special weight to legislative and regulatory measures. However, we must ensure that existing legislation is harmonious, eliminate contradictions or duplications, and especially avoid weighing down market operations with unnecessary legislation.

APPRAISAL

In an energy efficiency strategy, it is important not only to establish targets to attain, but also to measure the progress accomplished so as to readjust one's aim if necessary. It is also necessary to periodically appraise the effectiveness and efficiency of existing programs.

Not only must the government establish the potentials that can be achieved, it is also responsible for gathering and disseminating relevant information to monitor the progress of major energy efficiency indicators. The government must follow up programs under way adequately, directly or with partners, in order to modify the terms and conditions of these measures and even rescind them if necessary.

3 THE BUREAU DE L'EFFICACITÉ ÉNERGÉTIQUE

In 1977, the gouvernement du Québec created the Bureau des économies d'énergie (BEE). Located in Montréal, this office, which successively came under the ministère des Richesses naturelles and the ministère de l'Énergie et des Ressources, was assigned from the start the primary task of promoting energy conservation in the residential, institutional, commercial and industrial sectors as well as in transportation.

The first actions of the BEE dealt especially with home insulation and the analysis of energy use by Québec industries. At the time, the agency offered technical support, financial assistance and information through several programs, sometimes created in collaboration with the federal government and Hydro-Québec. Over the years, the office broadened the range of its actions and activities particularly by accepting to train its target clientele, being responsible for technology transfer, devising joint action plans, and publishing technical support documents.

In 1988, the Bureau des économies d'énergie becomes the Bureau de l'efficacité énergétique, and priority is given to actions dealing with the commercial and industrial sectors. The BEE makes available to industries financial aid and technical support, cooperates actively in the development of the Association québécoise pour la maîtrise de l'énergie, supports the progress of "Forum Énergie," conducts many activities to inform and raise public awareness, and takes part in energy efficiency demonstration projects.

The presence of the BEE among interested parties, its direct involvement in the field, its closeness to decision-making centres and its concrete actions in the commercial and industrial sectors are all extremely important assets in implementing **Québec's energy efficiency strategy**.

4 HYDRO-QUÉBEC'S "ENERGY EFFICIENCY PROJECT"

In November 1990, the gouvernement du Québec approved the Proposed Hydro-Québec Development Plan — 1990-1992 — Horizon 1999, which includes a wide-ranging "energy efficiency project."

Hydro-Québec's Energy Efficiency Project corresponds to the conditions set and the commitments made when the Parliamentary Committee on the Prospects of Electricity Supply and Demand was held in May 1990.

The action initiated by Hydro-Québec to use electricity more efficiently has several basic characteristics:

- This is a large-scale project. According to its revised scenario, Hydro-Québec will invest in the sole energy conservation component of the energy efficiency project 1.9 billion constant dollars (in 1991 dollars) by the year 2000, to which electricity consumers will add investments of 1 billion dollars. As mentioned, the program will save 9.3 TWh of electricity in 2000 (9.9 TWh in 2001), or 35% of the theoretical energy efficiency potential in the electricity sector in 1990. Hydro-Québec's action is aimed at all consumer classes, all markets that use electricity, and will consist of measures dealing with information, public awareness, technological and commercial support and financial assistance. More than twenty programs are now under way.

- The magnitude of Hydro-Québec's investments are a direct result of the structure and level of costs and prices in the electricity sector. For the government-owned utility, these investments correspond to the difference between the marginal cost and the average cost of electricity production: this means that the investments Hydro-Québec has chosen to make in energy efficiency are profitable for the utility, and will have the advantage of keeping rates at the lowest possible level.

- The energy efficiency project will be assessed and adjusted to take into account the performance of the programs created and the progress of the situation.

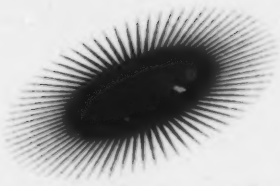
  The program set up by Hydro-Québec thus represents a major asset for **Québec's energy efficiency strategy**.

- By its magnitude, by the knowledge that Hydro-Québec has of the intended markets, the utility's action provides an irreplaceable support in the efforts towards a more efficient use of energy.

- The measures and actions proposed by the government in **Québec's energy efficiency strategy** will prevent any overlapping, any duplication with those of Hydro-Québec. On the contrary, government proposals will focus on markets or areas not serviced by the utility. Some measures will, however, require Hydro-Québec's collaboration. Such will be the case, for instance, regarding the general measures that apply to all energy sources.

- Control over Hydro-Québec's action as well as the integration of its Energy Efficiency Project with all the actions undertaken to conserve energy will both be assured as part of the progress reports the utility must submit periodically on its programs.

  This "merging" of Hydro-Québec's project and **Québec's energy efficiency strategy** should guarantee the best possible mobilization of the energy sector in favour of energy conservation.



Hydro-Québec's "Energy Efficiency Project"

Hydro-Québec's "Energy Efficiency Project" comprises two parts: energy conservation and consumption management. The project covers the residential, commercial, institutional and industrial markets. It is based on three strategic lines of action:

— informing and raising the awareness of clients;
— aid in identifying potential energy savings;
— the gradual introduction of financial incentives to acquire efficient products and equipment.

- **Part I: Energy Conservation,** includes the following activities and programs:

Public awareness — business communication

— TV messages;
— Hydro 90 and Hydro 91 magazines;
— Participation in shows and trade fairs;
— The 1-800-ÉNERGIE telephone line;
— Folders on energy efficiency.

Technological development, support for business, and trade research

— Fine-tuning of a residential water heater;
— Fine-tuning of a heat pump with non-electrical backup;
— Building a dual-climate chamber at the Institut de recherche en énergie du Québec (IREQ);
— Activities in trade research.

Financial Assistance

— Promotion of products to conserve energy (Econos) Phases 1 and 2;
— Energy analyses (Écokilo);
— Improving energy efficiency of independent systems;
— Energy analyses of buildings (commercial and institutional);
— Improving energy efficiency in Hydro-Québec buildings;
— Efficient lighting (commercial and institutional);
— Converting public lighting (commercial and institutional);
— Aid in introducing electrotechnologies — Phases I to III (industrial);
— Financial assistance for the purchase of high-efficiency motors (industrial).

- **Part II: Consumption Management,** includes the following programs:

— Interruptible power;
— Subsidies for the installation of dual-energy systems (New Dual-energy);
— Commercial, institutional and industrial dual-energy.

- Hydro-Québec's action strategy relies as much as possible on market mechanisms. It gives priority to business communication, that is, customer awareness.

- Hydro-Québec's energy efficiency strategy compares favourably with that of most other North American utilities. The government corporation's past efforts in consumption management have also allowed it to stay ahead of its neighbours in this area.

B GENERAL MEASURES

Québec's energy efficiency strategy proposes several major measures relating to all consumers in the residential, commercial, industrial and transportation sectors. These actions regard *public awareness, information, and research and development*, or constitute *economic and financial incentives* as well as *legislative and regulatory* interventions. Because of their overall impact, they will be presented independently of each sector concerned.

- These measures are to ensure that energy users are aware of the importance of energy efficiency and to provide some of the means necessary for better consumption management.
- These measures do not duplicate existing initiatives. Quite the opposite, they complement and support them, for the government does not intend to take the place of economic agents, whose know-how is indispensable to the dissemination of energy efficiency.

1 INFORMATION AND PUBLIC AWARENESS PROGRAMS

Over the past years, governments have carried out various programs to inform and raise the awareness of the general public or specialized groups about energy efficiency. In addition to these activities, Hydro-Québec has recently launched major ad campaigns dealing essentially with the uses of electricity. These campaigns are intended to modify behaviour as well as circulate information relative to existing energy efficient equipment. If we wish to obtain lasting behaviour changes, these actions must be repeated frequently during the coming years.

— Government action must therefore deal with information and public awareness as a priority; in particular, government measures will target natural gas and petroleum product consumers, especially transportation users, who are unaffected by Hydro-Québec's ad campaigns.

— We should point out that a special public awareness program to improve energy efficiency will be set up by Gaz Métropolitain, inc. As part of this program, the gas company will inform specialists in various sectors about the most energy efficient gas technologies. The program will therefore be aimed at engineering-consulting firms, contractors in heating and ventilation, real estate developers, manufacturers, equipment distributors, and the professional associations concerned.

— The ministère de l'Énergie et des Ressources will increase its regional action in energy efficiency. This is at once to raise public awareness in the various Québec regions to the identification and realization of energy conservation potentials and encourage economic activities related to energy efficiency. In close collaboration with the interested parties of the region and the organizations and associations concerned, the department will intervene in all Québec regions to facilitate the exchange of information and technology transfer, encourage local initiatives, identify needs and priorities and offer expert advice to companies and organizations.

2 SUPPORT FOR RESEARCH AND DEVELOPMENT

In the medium and long terms, long-lasting progress in energy efficiency rests on technological innovation. In Québec, we must therefore encourage research and development in, as well as the demonstration of, energy efficiency; we must also promote the mechanisms of technology transfer (such as adapting technologies developed elsewhere in the world and purchasing manufacturing licences).

— Funding for research and development is available from several federal and provincial departments. For its part, in 1991-1992, the ministère de l'Énergie et des Ressources has increased by 70% the funds distributed in connection with the Programme d'aide au développement des technologies de l'énergie.

The Fonds de développement technologique de l'environnement will also earmark resources for energy efficiency and the development of new technologies.

— The government will support as a priority energy efficiency research based on industrial projects (electrotechnologies, gas technologies, construction and insulation processes, the manufacturing of doors and windows, heat recovery systems, etc.).

3 EDUCATION, TRAINING AND UPGRADING

Information and public awareness of energy conservation are achieved through education, vocational training and upgrading.

— On the basis of the measures already applied and to significantly improve their impact, the government will implement special educational activities.

In the immediate future, these actions will be aimed at the high school and college levels with the publication of teachers' manuals. The purpose of these guidebooks is to help pupils develop appropriate attitudes and adopt responsible behaviour with respect to energy efficiency.

Moreover, an action plan aimed at these pupils will be prepared in a joint effort with the interested parties; it will integrate a program of courses, the production of materials, the organization of lectures and visits around a given theme, contests, and other activities.

— Systematic actions will also be carried out to upgrade knowledge and skills and provide vocational training. The purpose of this measure is to bring the various specialized clienteles, especially workers in construction, industry, transportation and agriculture to include concepts and techniques relating to energy efficiency into their professional activities.

The government will ensure the preparation of vocational training and proficiency courses in energy efficiency as well as the circulation of technical documents. This action will be carried out in cooperation with the major parties involved: organizations working in the field, associations, specialized corporations and firms, energy producers and distributors.

4 ADAPTING THE PROGRAMME DE PRODUCTIVITÉ ÉNERGÉTIQUE

Still in order to better inform and increase the awareness of energy consumers, the Programme de productivité énergétique, which has been offered for the past six years by the ministère de l'Énergie et des Ressources through the BEE, will be adapted to take into account the objectives of **Québec's energy efficiency strategy** as well as Hydro-Québec's programs.

— Initially, technical support and financial assistance will be directed to customers who use energy sources other than electricity and are therefore unaffected by Hydro-Québec's programs. At the same time, the program will coordinate the efforts and support the actions undertaken by urban communities, regional county municipalities and municipalities to enhance energy efficiency in buildings and equipment.

— Over the next few years, the Programme de productivité énergétique will integrate the monitoring of activities, performance appraisal and the circulation of results.

— In the longer term, the Programme de productivité énergétique will offer contractors a new service: analysis of the energy performance of new buildings at the design stage.

5 ESTABLISHING A GUARANTEE FUND

To finance energy efficiency measures, economic agents can resort to traditional financial means such as mortgage loans and short-term loans offered by financial institutions. Where equipment purchases are required, leasing is another means. This means of financing has so far been used very little for energy-efficiency projects in Canada because of the nature of the investments made.

In some cases, consumers can turn to the services of firms that design and apply energy conservation measures, finance the projects and operate the installations. These firms, called "third parties," which finance the work carried out according to a method similar to leasing, are paid from the money saved through their work.

The application of energy efficiency measures in housing constructions or commercial and industrial firms is in many ways risky business: it involves technical risks, company or operational risks, and financial risks. Engineering firms and manufacturers traditionally cover technical risks. Third-party firms accept operational risks and in some cases financing, but only where the nature of the undertaking involves minimum risk.

As regards financial risks, the nature of energy-conservation work is not always suitable to borrowing on collateral, which therefore limits the availability of credit. Indeed, in such a case, consumers must resort to traditional financing by committing their own margin of credit, to which generally conservative criteria are applied. This is often a major obstacle to the realization of the full potential of energy conservation.

- In collaboration with financial institutions, mechanisms will be set up to increase investments in energy conservation in the form of leasing. The government will also seek to favour, in cooperation with financial institutions and the companies concerned, the development of third-party firms.

- In order to offset these difficulties, the government will consider creating a private guarantee-fund with financial institutions. This fund should facilitate the financing of energy efficiency projects. Government aid could be granted to set up this risk fund. The fund would be available for the funding of projects in the commercial, industrial and apartment-building sectors.

6 LAWS AND REGULATIONS

— The Act respecting the energy efficiency of electrical or hydrocarbon-fuelled appliances is a clear example of the priority given to energy efficiency by the government. The Act, passed in June 1991 by the National Assembly, will become effective in the spring of 1992, along with accompanying regulations.

Basically, the purpose of this law is to promote energy efficiency. It establishes efficiency or conservation standards applicable to certain household appliances as well as to heating and air-conditioning equipment manufactured or marketed in Québec. At a later date, this law will serve to introduce yet higher standards for the appliances concerned, should this be necessary.

— The Regulation respecting energy conservation in new buildings, which applies to the construction of residential, institutional and commercial buildings, has recently been updated. This revised regulation will become effective in the spring of 1992.

Moreover, a more thorough revision will be made in the next two years to raise energy efficiency levels. To this end, work is now under way at the Conseil national de la recherche, with the financial and technical backing of the ministère de l'Énergie et des Ressources.

7 ELECTRICITY RATE STRUCTURE AS AN ENERGY EFFICIENCY TOOL

The electricity rate structure can be a privileged means of encouraging a more efficient use of available electricity resources. However, this measure must be used carefully: whether we refer to the rate level or the rate structure, changes to the current rate scale would have multiple effects, which must be appraised accurately. The customers' ability to pay as well as the comparative advantage that access to low-cost electric resources represents for Québec economic agents must both be protected in whatever use we make of electricity rates as a tool of energy efficiency.

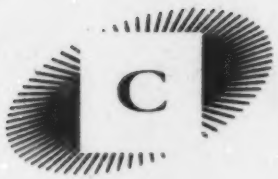
The gouvernement du Québec would like this question to be treated explicitly during the discussions on the implementation of its **energy efficiency strategy**. In December 1990, Hydro-Québec undertook, at the government's request, an in-depth revision of the existing electricity rate structure, especially to foster a more rational use of electricity. The final report of the revision will be filed in July 1992, but already several possibilities have been looked at very closely.

- In the **residential sector**, we are considering emphasizing seasonal domestic rates (Rate D) and introducing an optional time-of-use rate, very likely based on temperature. This raises several questions. Can these measures lead consumers to significantly improve their behaviour with respect to energy use? Would not an action toward seasonal rates risk being "cancelled" by the practice of monthly billing introduced by Hydro-Québec? These questions will likely be dealt with in the next few months.

- In the **commercial and institutional sector**, where the rate structure is relatively complex, we could simplify the structure of small- and medium-power rates (Rate G and Rate M) so as to eventually introduce a differentiated time-of-use rate structure for these customers; as for public lighting, modified service rates would encourage the use of more efficient lighting equipment.

- In the **industrial sector**, large-power rates (Rate L) were revamped in 1990 to eliminate rates on a sliding scale. This reform will be completed in 1992. Hydro-Québec is also studying in this sector the possibility of introducing seasonal rates to reflect more accurately supply costs incurred by the utility. The impact of this modified rate structure on the ability of companies to compete must be accurately appraised.

With the rate structure, the government therefore has at its disposal in the electricity sector a very promising energy efficiency tool, but whose impacts on consumers must be carefully weighed.



RESIDENTIAL SECTOR

The residential sector alone accounted for one-fifth of Québec's total energy consumption in 1990. This is a sector where great strides have been made in energy efficiency, particularly during the 1980s. The Act respecting energy conservation in new buildings, as well as government programs and Hydro-Québec projects have significantly improved the conditions of energy use in this sector.

However, some parts of the residential sector have been neglected, such as apartment buildings. Appropriate and innovative measures must be taken to tackle this market segment, especially since it is the field of highest energy consumption. The large number of economic agents concerned, their lack of information, their difficulty in adopting consistently rational behaviour require that special efforts be made to increase public awareness of energy efficiency.

For this entire sector, therefore, two priority measures regarding *demand management* and the *"energy rating" of buildings* will be proposed by the government. Other actions will complement these measures.

1 THE TOOLS OF CONSUMPTION MANAGEMENT

For residential energy consumers to be informed and made aware, they must first have a firm grasp of what consumption is and what it costs. The problem of misperceiving what is at stake in energy consumption arises especially in the apartment sector.

— **Over the next few years, the government intends to install by stages individual devices to measure electricity consumption in new apartment buildings. This measure will be applied with the collaboration of Hydro-Québec and the cooperation of the organizations concerned.**

— **The energy bill is a privileged tool in raising the awareness of consumers. The government will require energy distributors, when billing, to provide without delay detailed information on the costs incurred, on how much energy was consumed, and on possible comparisons with a standard housing unit. Moreover, electricity bills will contain messages to raise the public's awareness of energy efficiency.**

2 "ENERGY RATING" OF BUILDINGS

In cooperation with the professional associations concerned and financial institutions, the government will propose in the medium term an "energy rating" system that builders of single-family homes and apartment buildings can use to advantage.

Such a program is intended to link the value of a residence and available financing to its energy performance, which will be made public in the form of an "energy rating" system recognized by all. If this program yields satisfactory results, it will be extended to all existing residential buildings.

As regards energy efficiency, this measure should improve the quality of the construction, materials and equipment that have an impact on energy consumption.

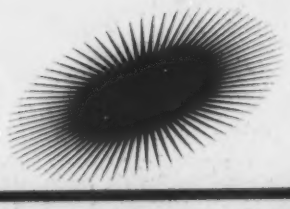
3 OTHER MEASURES RELATING TO THE RESIDENTIAL SECTOR

Two kinds of economic and financial incentives will be proposed in the form of programs aimed at specific customers.

— **By 1993, the government will set up its Programme d'information et de sensibilisation à l'efficacité énergétique (an information and public awareness program) for people living in subsidized housing. Such a program is aimed at underprivileged customers for whom electricity bills represent a heavy financial burden and whose lodgings as a rule rate**

very poorly in energy efficiency. The terms and conditions of such a program will require the cooperation of several agents, community groups, public agencies, urban communities, municipalities as well as energy producers and distributors.

— In the residential and apartment building sector, gas distributors will integrate — in their programs to convert and replace heating equipment — incentives to acquire the most efficient technologies. The Régie du gaz naturel must nevertheless first approve the proposed changes.



Actions of the Bureau de l'efficacité énergétique in the building sector from 1978 to 1991

*The **Programme d'isolation des maisons** (PIM), set up in 1978, was aimed at improving the building insulation of single-family houses built before 1961, which represents 400,000 residences. Three years after it was created, the program had reached 23% of its customers, distributing 22.5 million dollars in subsidies. Moreover, the **Programme d'isolation** on the Îles-de-la-Madeleine received 500 subsidies for a total cost of 1.8 million dollars.*

In order to reach a greater number of customers, better inform consumers and change their consumption patterns, the ministère de l'Énergie et des Ressources prepared, as early as 1981, a new program comprising two main elements: informing consumers and analysing energy use in dwellings.

An information and public awareness campaign offered residential building owners brochures on the techniques of weather stripping and insulation, heating and ventilation as well as a telephone information service for consumers.

*Hydro-Québec's **Energain** program offered consumers personalized energy analyses including a complete assessment of the premises and a list of work to be done in order of importance. The costs of **Energain**, which totalled 48.6 million dollars, were shared equally by Hydro-Québec and the ministère de l'Énergie et des Ressources. This program, which ended in 1985, helped carry out the energy analysis of 257,000 housing units.*

*Effective since August 1983, the **Act, and Regulation, respecting the conservation of energy in buildings** — a second major action of the department — are designed to ensure the use of energy-conserving building materials and methods as soon as new buildings are put up. The regulation is currently being updated and will include higher standards and stricter requirements regarding mechanical ventilation.*

*More recently, passage of the **Act respecting energy efficiency of electrical or hydrocarbon-fuelled appliances** will help prepare standards of energy efficiency for household, heating and air-conditioning appliances.*

*In order to act at the source, that is, when housing constructions are under way, the BEE has set up a **Programme de perfectionnement** intended for general contractors.*

*Finally, the BEE has put together a **computer model of the total number of buildings** in order to give a more tangible expression of the savings that buildings as a whole are likely to achieve in Québec. This data base can simulate various scenarios and measure energy efficiency gains for an entire region, an industry, or all of Québec. Real estate agencies can thus discover markets and test their marketing assumptions of new energy efficiency techniques.*

Gaz Métropolitain and Energy Efficiency

A large part of research, development and demonstration activities carried out by Gaz Métropolitain's Datech group is an effort to improve the energy efficiency of the equipment of natural gas users. The budget of this service will be about 4 million dollars in 1982. Added to this are training activities for equipment installers, who have a direct influence on the energy efficiency of the apparatus.

Moreover, Gaz Métropolitain manages a certain number of commercial programs to convert to natural gas or replace obsolete equipment by installing new energy-efficient equipment including, among other things, boilers, burners and heaters. The budget for these programs will reach 8.8 million dollars in 1982.

D INDUSTRIAL SECTOR

The industrial sector, which in 1990 accounted for more than a third of Québec's energy consumption, groups at once major companies, which have at their disposal sufficient resources to properly manage their energy consumption and small- and medium-sized companies, where information on energy efficiency is not readily available.

Among all these companies, "energy-intensive industries" (EII) form a very important group as regards energy efficiency: in 1990, the EIIs alone represented a quarter of Québec's total energy consumption and 71% of demand in the industrial sector. For these companies, however, energy efficiency awareness is an accomplished fact. Energy plays such a critical role in their production costs and the profitability of their operations that the best possible use of energy lies at the very core of company management.

In the industrial sector, the government does not intend to take the place of economic agents in managing energy demand. The measures proposed will instead target the two following objectives:

— *Circulate all the information* required by large as well as small companies;

— *Encourage the introduction of new technologies* by financing feasibility studies and aiding demonstration.

1 COOPERATION AND GROUP ACTION THROUGH SECTOR-BASED COMMITTEES

— **Permanent joint-action mechanisms will be set up in the form of sector-based committees composed of members from the government and the parties most concerned with energy efficiency.**

— **These committees will determine energy conservation objectives and the means to achieve them. The groups will follow the approach adopted as part of the Canadian industry's energy conservation program, which has produced convincing results since 1975.**

Actions of the Bureau de l'efficacité énergétique in the industrial and commercial sector

In 1978, the ministère de l'Énergie et des Ressources launched the ***Programme Énergiebus*** *as part of a federal-provincial agreement. The program's objective was to offer companies, particularly small- and medium-sized ones, a special service: that of analysing their energy consumption. Between 1978 and 1983, more than 750 companies benefited from this program.*

The BEE also took part in the Energy, Mines and Resources Canada's ***National Energy Audit Program*** *and analysed the consumption of 200 companies.*

Since 1985, the BEE has analysed, through the ***Programme de productivité énergétique****, energy use especially in the industrial and commercial sector and recommended the application of energy conservation measures. Whenever the proposed measures require major investments, the department grants financial assistance for engineering-consulting firms to carry out feasibility studies. Some 500 feasibility studies have thus been conducted and a total of 4.9 million dollars have been granted in subsidies; these studies represent potential investments of 250 million dollars and translate into 110 million dollars in energy savings.*

2 CIRCULATION OF SPECIALIZED INFORMATION

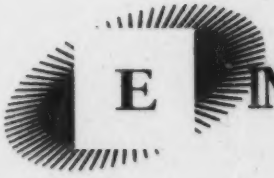
The government will establish within the current structure of the BEE a centre of experts assigned to provide small- and medium-sized companies with technical information on the equipment, processes and materials likely to improve energy efficiency in companies. These same services will also be offered to industries when building new facilities.

Moreover, in cooperation with regional interest groups and with the backing of the AQME, the government will systematically extend the "Forum Énergie" discussions to the industrial sector.

3 RESEARCH AND DEVELOPMENT IN THE NATURAL GAS SECTOR

— Gaz Métropolitain, inc. has undertaken with industrial and university partners a major research and development program in gas technologies. Its implementation will offer Québec industry the most productive gas technologies, thus opening up a significant potential for energy efficiency improvement. Over the next five years, several projects will be carried out particularly to improve energy efficiency in industrial operations with high potential.

— To implement these projects, the gouvernement du Québec will grant financial support to the centre for research into gas technologies.



INSTITUTIONAL AND COMMERCIAL SECTOR

Of the four major demand sectors, the institutional and commercial sector is the one that contributes the least, in absolute value, to Québec's total energy consumption: in 1990, this sector represented 16.3% of Québec's energy demand.

However, this is the sector that groups the various systems controlled directly or indirectly by the State, or for which it has at its disposal means it can quickly put to use. We are referring here to government departments as well as the educational and health systems. However, a large part of energy consumption is controlled by municipalities.

This is a very heterogeneous sector. The measures proposed by **Québec's energy efficiency strategy** will give priority to *government and public systems*. The potentials for energy efficiency are considerable, and the public sector must become a true model of energy efficiency. Moreover, *with the cooperation of municipalities and regional county municipalities (RCMs)*, efforts to use energy more efficiently will be extended to all *municipal systems*.

Along with this priority action, efforts will be pursued to raise *public awareness of energy efficiency* throughout the commercial sector.

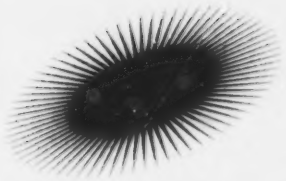
1 PREPARATION OF AN INTEGRATED AND PERMANENT ENERGY MANAGEMENT PROGRAM FOR PUBLIC AND PARAPUBLIC ESTABLISHEMENTS

The government will prepare as a priority, and with Hydro-Québec's collaboration, a new energy management program for all government departments as well as public and parapublic agencies.

This program will include all the buildings and motor vehicles that belong to the government. It will also affect all the buildings and constructions the government and its agencies lease. Energy efficiency standards will be integrated into the programs and management of government departments and agencies, and building and motor-vehicle managers will be given the appropriate means to apply them. This new program will include training staff members, monitoring actions and appraising performance. A five-year action plan committing the government and its agencies will be prepared in 1992.

2 PARTICIPATION OF MUNICIPALITIES AND RCMs

— The government will sign general agreements with major cities to ensure that municipal buildings and motor-vehicle fleets are managed in the most effective way possible. An agreement between the gouvernement du Québec, the federal government and Ville de Montréal is currently being drafted. This agreement will make available to Montréal the technical expertise of two government levels as well as joint financing for programs and projects dealing with energy efficiency as well as alternative energy sources.



Actions of the Bureau de l'efficacité énergétique in municipalities and RCMs

To help elected municipal officials and managers become more attuned to energy conservation, the BEE has produced, with the consent of the ministère des Affaires municipales, a number of information documents regarding energy conservation measures applicable to buildings, motor-vehicle fleets, land use and road traffic.

Engineers, administrators, general managers, urban planners and land surveyors have been reached during seminars and information sessions.

Energy analyses have been performed in municipalities that have requested them. Moreover, individual work sessions have been held on management plans in most regional county municipalities.

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Actions of the Bureau de l'efficacité énergétique in the public and parapublic sectors

From 1983 to 1986, a vast energy efficiency improvement program of 10,000 buildings in the public and parapublic sector increased the overall energy efficiency of buildings by 10%.

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Actions of the Bureau de l'efficacité énergétique in the service sector

Commercial buildings in Québec consume, on the average, more than 495 kWh/m²/year, while public buildings only consume 350 kWh/m²/year. To lower this figure, the BEE has set up a special program addressed to owners of shopping centres, office towers and other commercial buildings. The Forum Énergie program brings these owners together by region. The program is aimed at increasing energy efficiency by an average of 10%. We hope to attain this objective by raising public awareness and discussing ways of using energy rationally.

In 1988, other regional programs were set up in l'Estrie and Saguenay—Lac-Saint-Jean, and three new Forums: Metropolitan Québec, Bois-Francs and Mauricie were created in 1991.

— As will be seen in the section on transportation,[7] the government will see that energy efficiency is included in the revision of RCM management plans.

  Several decisions made in connection with management plans have indeed influenced energy consumption. Limiting urban sprawl, encouraging public transportation, car pools or shared-rate taxis as well as promoting medium- and high-density residential development — all these means would foster a more efficient use of energy.

— The government will bring to RCMs and municipalities the technical support necessary to implement energy efficiency programs. This assistance will be in the form of expertise, feasibility studies and the circulation of specialized materials. Permanent joint-action mechanisms will be set up with municipalities and RCMs to facilitate the dissemination of energy conservation.

3 ADAPTING "FORUM ÉNERGIE" DISCUSSIONS TO THE COMMERCIAL SECTOR

In all Québec regions, owners of shopping centres, office buildings and various commercial buildings will be invited to take part in "Forum Énergie" meetings, where managers are informed and made aware of the most efficient techniques in the field of energy consumption.

4 INCENTIVES TO ACQUIRE GAS TECHNOLOGIES

As in the apartment building sector,[8] gas distributors will integrate incentives to acquire more efficient technologies into their programs for heating equipment conversion and replacement. These changes must also be approved by the Régie du gaz naturel.

7 See below, p. 53 ff.
8 See above, p. 46.

F TRANSPORTATION SECTOR

The results that will be achieved in the transportation sector will be crucial for the success of **Québec's energy efficiency strategy**. The transportation sector, which in 1990 represented somewhat more than a quarter of Québec's total energy consumption, is also the one that consumes nearly two-thirds of the oil used in Québec.

This means that any improvement in energy use in this sector has a direct and particularly significant bearing on our energy situation: by being less dependent on petroleum products, we enhance the real or imagined effects of oil consumption on the environment and reduce Québec's dependence on imported oil.

According to the quantifications presented previously, the measures proposed by **Québec's energy efficiency strategy** in the transportation sector alone account for nearly 60% of the impact of all government action.

These measures are designed to improve the use of energy in the transportation sector basically in three ways:

— As regards the transportation of people, the government will seek to persuade consumers to *change their behaviour* so they will make greater use of public transportation, and will intervene to *improve the energy efficiency* of all existing motor vehicles in Québec.

— As for the transportation of merchandise, the energy conservation potential of rail transportation should be further developed.

— More general measures — such as the policies issued by public authorities regarding land use — will have a considerable long-term impact on energy consumption for transportation purposes. The urbanization that has taken place over the past twenty years, urban sprawl and the ensuing development of suburbs far from urban centres, all lead to travel needs that translate directly into energy consumption. In future land-use policies, this link between development and energy consumption must be taken into consideration.

1 ENCOURAGING THE USE OF PUBLIC TRANSPORTATION

Measures to inform and raise public awareness, but also economic and financial incentives will be adopted to get consumers to make greater use of public transportation.

- **The government will continue to encourage, particularly through financial aid, the introduction of permanent lanes for buses, and eventually car-pools, in cities. Bus lanes are a major and relatively low-cost action to improve the quality of public transportation. Should it become necessary, these lanes can be set up for two-way traffic on the routes considered.**

- **The government will give technical and financial support to set up "incentive parking lots" at the end of bus routes or near train stations. Financial aid will be ensured as part of existing programs of the ministère des Transports.**

- **As announced by the Conseil du trésor, the subsidy granted by the government to employee parking will be abolished so that civil servants get the true "price signal" corresponding to the cost of such parking. This measure should prompt all companies to take similar measures with their employees.**

- **As for taxes, the gouvernement du Québec will study the possibility of no longer recognizing the deductibility of parking expenses paid by companies on behalf of their employees.**

- With respect to employers, the government will study the possibility of introducing various tax incentives all aimed at encouraging the use of public transportation. This could consist in encouraging companies to pay for the public transportation of their employees, or exempting employees who take advantage of such an offer from paying the taxes generally collected on such benefits.

2 IMPROVING THE EFFICIENCY OF EXISTING MOTOR VEHICLES

- Raising the efficiency standards for motor vehicles is considered a priority in **Québec's energy efficiency strategy**. This measure alone would help achieve the greater part of the quantified target retained by the government in the transportation sector.

  The objective, in the near and medium term, is to improve the energy characteristics of all motor vehicles in Québec by modifying the distribution of these vehicles according to their different types. In the longer term, raising the energy efficiency standards for motor vehicles, if applied throughout North America, should bring about technological improvement for all motor vehicles.

  During the 1980s, the American government imposed, for motor vehicles, efficiency standards that have remained unchanged for several years. The federal government of Canada, for its part, did not think it was necessary to impose similar standards.

  The gouvernement du Québec believes that new objectives to improve the energy efficiency of existing motor vehicles should be defined and adopted. The ideal would be that such standards be established throughout Canada. The government will therefore make the necessary representations so the Canadian government — after consulting with other levels of government, industry and consumers — might take immediate action. Moreover, such action would coincide with the intention expressed by the federal government when it released its "Green Plan" in December 1990.

- Should it be impossible to improve the energy efficiency of existing motor vehicles by means of these standards, the gouvernement du Québec will have to consider economic and financial measures, which are much more coercive for consumers themselves. These measures could be in the form of recalculating registration fees adjusted according to the energy efficiency of vehicles, fees that would even cover the use of air-conditioners if technology does not succeed in improving the energy efficiency of this type of equipment.

3 TRANSPORTATION OF MERCHANDISE

The transportation of goods now represents more than a third of the energy consumption in the transportation sector. Among the methods used, road transportation is the least energy efficient — after air transportation. It is estimated that rail transportation currently consumes two to three times less energy than road transportation for each ton of merchandise transported. Therefore, any increase in the transportation of goods by rail will improve our overall energy efficiency.

- Québec's policy relating to the transportation of merchandise must take into account the potential savings to be made by intermodal transportation or road transportation complemented by rail transportation, for long hauls. The steps already taken by the ministère des Transports du Québec concerning rail transportation are the first stage of this plan.

4 LAND-USE

The splintered and low-density type of urban development to which road infrastructures contributed has serious consequences for energy consumption. Land use must therefore be a component of **Québec's energy efficiency strategy**.

Land use is the shared responsibility of several parties. As decision centres are relatively autonomous and coordination can be lacking, this responsibility has not always been handled effectively. There result unbalanced situations and shortcomings in the urban fabric and the distribution of activities on a given territory.

It would therefore be advisable that actions in the field of transportation be part of a land-use plan and be assessed as to their consequences for energy consumption.

- The government aims to foster collaboration when land-use and transportation systems are being planned. The revision of land-use plans is a good opportunity to argue the importance of the integrated planning of transportation and land use.

- The ministère des Transports will draw up, mainly for Québec's urban centres, transportation plans fostering the consolidation of urban areas. These plans will foster the optimization of movement, while encouraging public transportation.

  The preparation of transportation plans is a basic measure that will lead to the integration of the environmental dimension from the very start of the planning stage. Regional transportation plans will provide the ministère des Transports with a frame of reference to link transportation, land development and the environment.

  This is the way energy efficiency can be integrated as an appraisal criterion as soon as the planning process for projects begins. Because future transportation plans will be multimodal and will propose an action plan with a well-defined land base, the various methods will be appraised in a integrated manner by considering, among other things, how they improve energy efficiency.

- In connection with these assistance programs for public transportation, the government, in collaboration with the various parties concerned with land use, could require higher land-use ratios at the perimeter of transportation infrastructures. However, these standards will be insufficient to stimulate housing demand along subway and rail lines; they must be accompanied by other construction standards adopted by municipalities, standards that concern the size, quality and safety of the lodgings to be built or renovated.

5 SUPPORT FOR RESEARCH AND STUDIES IN THE TRANSPORTATION SECTOR

- As part of existing programs, funds will be earmarked for research and development relating to efficiency in transportation methods and to the use of alternate fuels such as hydrogen, methanol and natural gas.

Actions of the Bureau de l'efficacité énergétique in the transportation sector

As early as 1979, an order from the Conseil du trésor, issued on the advice of the ministère de l'Énergie et des Ressources, recommended the purchase of lighter government vehicles to cut fuel consumption.

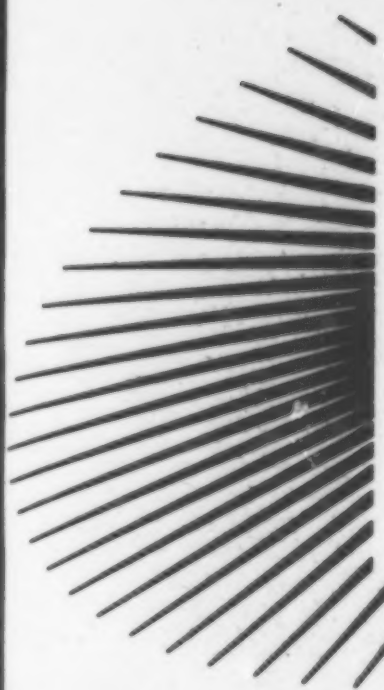
In 1980, the BEE undertook a public information campaign to encourage people to purchase motor vehicles that were energy efficient, use vehicles less often for individual transportation, and opt for car-pooling. To support this action, the government amended the Transport Act to authorize car-pools and shared taxis. In addition, the notion of energy efficiency was included in the compulsory course drivers must take.

The BEE has also analysed energy use and efficiency in trucking companies, held seminars in fleet management and developed a program to upgrade the knowledge and skills of truck drivers.

- Special attention will be given to technological endeavours in public transportation. For example, support will be granted to research into the environmental impacts of public transportation.
- The government will study the possibility of setting up a program to reduce commuting between home and workplace, which would spur large companies to draw up plans enabling their employees to cut down on car travel.
- Studies on the economic, environmental and energy impacts of the displacement of populations to the suburbs will be conducted in universities and general research centres.

6 INFORMATION AND PUBLIC AWARENESS: SPEED LIMITS

There is a direct link between energy consumption and the speed at which a motor vehicle is travelling. Therefore, information and public awareness programs set up to encourage drivers to obey speed limits on all Québec roads and highways help achieve the goal of energy efficiency. Collaboration on this score with organizations involved in road safety could be quite appropriate.



3

FINANCING

Part of the measures proposed by the government require adequate financial resources if they are to be implemented: the *financing of energy efficiency measures* is a necessary condition of the success of the government's plan. The proposals presented are aimed at ensuring the financing of these measures. By making collaboration and partnership a priority, the proposals are also a concrete expression of the spirit with which the government wishes to implement **Québec's energy efficiency strategy.**

A THE GOVERNMENT WILL ACCEPT ITS RESPONSIBILITIES

Since 1977 and the creation of the BEE, the government has invested more than 100 million dollars in the promotion and dissemination of energy efficiency. For the year 1991-1992 alone, the sums allocated to the BEE represented nearly a quarter of the budget of the Energy Sector of the ministère de l'Énergie et des Ressources, or 3.8 million dollars.

Over the next few years, the government will continue this financial support, which is the very basis of the financing of **Québec's energy efficiency strategy**.

B ENERGY EFFICIENCY: A SHARED RESPONSIBILITY

The continued financial commitment of the gouvernement du Québec in the promotion and dissemination of energy efficiency is an essential condition of the success of the measures proposed. However, it would not be logical that the State alone bear the cost of the actions proposed.

- The various measures proposed by the government to improve energy efficiency will produce benefits for all consumers, individually and collectively. It is therefore normal that these beneficiaries share, at least in part, the financial responsibilities of the measures considered.
- Energy producers and distributors must also become financially involved in these efforts aimed at greater energy efficiency. We know that this is already the case for the electricity sector, where structures for both cost and rates make investments earmarked for energy conservation profitable within a short time. For energy sources as a whole, the involvement of producers and distributors in a common effort towards greater energy efficiency becomes an increasingly important argument in marketing strategies. We should add that the financial commitment of producers and distributors is often the only way to associate the consumers benefiting from the various measures applied: energy producers and distributors have, in any event, the possibility of integrating their contribution to energy efficiency into their production costs, and therefore to bill energy consumers, the final beneficiaries of the measures thus financed.

Energy consumers, producers, distributors should therefore be as directly involved as the State in the financing of the energy efficiency measures proposed by the government.

C FINANCING THAT MUST BE COORDINATED

The proposal presented by the government entails therefore that **Québec's energy efficiency strategy** be financed jointly by public and private funds, provided by the State, companies and individuals alike. It is imperative that the best possible cooperation be assured between these multiple sources of financing. Were this not the case, the implementation of the energy efficiency measures could be accompanied by duplications and overlapping, which might jeopardize the results of the efforts expended.

Indeed, the financing of the measures proposed by **Québec's energy efficiency strategy** must be a concrete illustration of the partnership and joint action that the government favours.

- To ensure the coordinated financing of energy efficiency measures, several methods are possible: for example, the application of some measures proposed by the government could be assigned directly to the major players concerned — energy producers and distributors — while the BEE would very flexibly assure coordination by supervising the efforts deployed and the results obtained. These results could be made public, much like the Bureau de l'inspection et d'information du prix de l'essence (BIPE) does with respect to gasoline prices in outlying regions.
- We could further coordinate the financing of **Québec's energy efficiency strategy** by setting up a mechanism to channel private funds to carry out joint projects.
- Other methods are also possible. For example, a nonprofit corporation could be created that would receive both government subsidies and private contributions, and would be controlled by a Board of Directors where representatives of the contributors would sit. This collaboration between the State and its partners might also come about project by project, with some measures being jointly financed by public authorities and a private party.
- At any rate, the methods chosen must meet a condition the government deems essential: the financing of the measures proposed by **Québec's energy efficiency strategy** must come from all the parties concerned, while the State has the mission of ensuring the required coordination and the optimal use of the various financial sources.

D OBJECTIVE: FREE UP ANNUALLY 10 MILLION DOLLARS FOR ENERGY EFFICIENCY

- We have evaluated the cost of the measures proposed in **Québec's energy efficiency strategy**: the actions that require specific financing entail, within a given period of time, that an annual budget of ten million dollars be available. This budget, which is comparable to the cost of similar actions implemented in major industrialized countries, would of course be added to the investments made by Hydro-Québec to carry out its own energy efficiency programs.

- To achieve this budget objective, several approaches are possible. We must first recall that about a third of this goal is already assured thanks to the appropriations the government grants for energy efficiency through the BEE.

  — We have underscored that consumers, the main beneficiaries of greater energy efficiency, should logically pay part of the costs. Thus, whenever beneficiaries — whether individuals or companies — of a given measure can be identified, the BEE will charge them for at least part of the costs incurred. The BEE will therefore gradually introduce rates for some energy analysis and consulting services it offers its customers in the industrial, institutional and commercial sectors. However, the government will continue to absorb part of the costs, and rates will be adjusted so that their application will not prevent energy efficiency objectives from being attained.

  — The contribution of energy producers and distributors should constitute the other source of funding for the proposed measures. This contribution would be coordinated according to one or the other of the methods mentioned above. In the case of Hydro-Québec, an eventual contribution would be drawn from the funds for the utility's "Projet d'efficacité énergétique" to avoid a double contribution. In general, it is imperative for the government that the contribution of producers and distributors be divided fairly between each energy source concerned, the ideal being that the financial involvement of each interested party be voluntary.

One or the other of the various methods mentioned should guarantee such an involvement.

The success of Québec's energy efficiency strategy presupposes adequate financing that can be raised in a relatively short time. The government would like the various parties concerned with the energy sector to state the approach they prefer, within the framework just defined. The objective is to enable the government, in collaboration with the interested parties, to channel into the dissemination of energy conservation the financial resources necessary for the success of Québec's strategy as a whole.

4

IMPACTS

The measures proposed by the government in **Québec's energy efficiency strategy** will be in addition to Hydro-Québec's programs and the energy conservation achieved by all Quebecers to significantly reduce the growth of energy demand.

This slowing of the progress of energy consumption will have significant impacts on our economic situation and environmental structures. Several of these impacts can already be identified, even quantified.

- The development of an energy efficiency industry will provide a direct boost to *employment* and *economic activity*.
- On the *macroeconomic* level, the cutting of total energy-related expenditures alone would allow Québec to save 1.5 billion dollars in 2001.
- Moreover, the measures analysed as part of **Québec's energy efficiency strategy** will have immediate consequences on the energy bills of individuals.
- As a contribution to sustainable development, increased efficiency in the use of energy will have multiple impacts on the *environmental balance*, significantly improving the situation compared to what it would be without energy conservation. In particular, we can already estimate the gains expected with respect to the emission of certain polluting gases, especially carbon dioxide.

A EMPLOYMENT AND ECONOMIC ACTIVITY

1 ACTIVITY AND JOBS CREATED

Québec's energy efficiency strategy entails and supports a number of measures, actions and initiatives that create economic activities.

- The activities created will considerably exceed the sole financial amount of the actions carried out, because of the "leverage" of the proposed measures. This "leverage" means that most of the measures included in **Québec's energy efficiency strategy** will spur economic agents themselves to invest in energy conservation: in sum, the investments triggered in the wake of the government measures will be a multiple of the sums that will have been injected from the start as part of these actions.

- All of these investments will themselves create jobs — direct jobs, indirect jobs and induced jobs.

  — Direct jobs are jobs created in the areas directly linked to energy efficiency: all the professions and trade associations involved in renovating buildings and installing equipment are therefore immediately affected by energy efficiency measures. The efforts deployed by energy consumers to use energy more efficiently will thus create jobs in the activities sectors concerned (architects, engineering consultants, electricians, plumbers, carpenters, etc.).

  — Energy efficiency is also a source of **indirect jobs**. We are alluding here to the impact that the various measures proposed will have on the equipment and energy-related materials sector.

  This indirect impact will be all the more important since Québec companies will take whatever work is offered them. In each major sector of activity, we can already point out producers that could benefit from the new possibilities offered by **Québec's energy efficiency strategy**.

  The impact of energy efficiency on Québec's economic activity will depend, however, on the dynamism of manufacturers and their ability to take advantage of a developing market over the next few years. **Québec's energy efficiency strategy** includes research and development orientations that should support the initiatives of Québec companies.

  — Finally, Québec's economy as a whole will benefit from the effect induced by the overall remuneration that will be paid for direct and indirect activities relating to energy efficiency. This **induced effect** results from spending by households who earn wages and other remunerations paid by contractors and suppliers of goods and services linked to energy efficiency.

- It is always risky to **quantify**, even approximately, the activity and the jobs created by investments in energy efficiency. This cannot be accurately appraised because of too many unknowns. It is, however, possible to quantify approximately the impacts that **Québec's energy efficiency strategy** could have on investments and jobs from studies that are available: the economic impacts of British Columbia Hydro's "Power Smart" program[9] that have been analysed and can be compared with Hydro-Québec's assessment, or with the conclusions of a study commissioned in the mid-1980s by the ministère de l'Énergie et des Ressources on the spinoffs from the Programme de productivité énergétique in the industrial, commercial and institutional sectors.[10]

  — As regards the "leverage" of financial actions in favour of energy efficiency, the study from British Columbia evaluates at 2.09 dollars per 1.00 dollar

9 Mark Jaccard and David Sims, "*Employment Effects of Electricity Conservation: The Case of British Columbia*", **Energy Studies Review**, Vol. 3, No. 1, 1991.

10 "Évaluation des retombés économiques du Programme de productivité énergétique dans les secteurs industriel, commercial et institutionnel — période 1983-1985," report prepared for the Bureau de l'efficacité énergétique, Tecsult inc., August 1988.

the ratio of total investments triggered by these financial actions. According to this report, the subsidies analysed — which reached 225 million dollars — would generate total investments of 470 million dollars.

Hydro-Québec obtains similar results: over the next decade, the energy conservation component of Hydro-Québec's Programme d'efficacité énergétique would trigger total investments of 3.1 billion dollars (1991 dollars) from capital investments of 1.9 billion dollars — which therefore represents a ratio of 1.6.

This ratio probably should be still higher for **Québec's energy efficiency strategy** because of the types of actions proposed. The nature of these measures (information, public awareness, feasibility studies, loan guarantees, etc.) should give them very much "leverage." The 1986 study on the Programme de productivité énergétique set this ratio at 8 to 1 — with each dollar invested in the program triggering eight times more investments.

To the extent that the actions recommended by **Québec's energy efficiency strategy** will be targeted and articulated with respect to activities with maximum impact, it would not be surprising if we recorded "leverage" of this order. The government's financial objective is to channel into energy efficiency, as part of the various measures proposed, about 10 million dollars a year. Over a period of ten years, **Québec's energy efficiency strategy** will raise 100 million dollars, invested by the government and its partners, which could therefore call for total investments of 500 to 800 million dollars. We should point out that this amount includes only direct investments, to which we should add the sums that will be spent, as part of the orientations chosen by the government, by public authorities, constructors and users of the transportation sector.

— These investments will in turn create jobs. The British Columbia study evaluates at nearly 6,500 the number of direct, indirect and induced jobs created by investments in energy efficiency, or 13.5 person-years per million dollars invested. The 1986 Québec study resulted in a higher ratio (18 person-years per million dollars invested).

By retaining the British Columbia evaluation, we can therefore assess between 7,000 and 10,000 the number of jobs in person-years that would be created or supported within ten years by **Québec's energy efficiency strategy**. Half of these jobs, or 3,500 to 5,000 person-years, would be created directly in the field. Other economic spinoffs in terms of employment would be distributed almost evenly in indirect and induced effects.

These job creations would be added, of course, to those linked to Hydro-Québec's "energy efficiency project." The utility estimates that the energy conservation component of this project would support the employment of 30,000 person-years over the same period.

Québec's energy efficiency strategy could therefore have quite considerable impacts on employment and economic activity. We should add that this estimate of the direct and indirect activity generated by energy efficiency does not take into account the even less measurable effects of savings on energy bills, savings that will be reinjected at least in part into the economy and in turn will create activities.

2 CHARACTERISTICS OF JOBS CREATED

The importance of energy efficiency for jobs and economic activity does not only stem from the number of jobs that can be created by the investments energy efficiency attracts. Economically, investments in energy efficiency translate into the rise of activities that are very promising in terms of development and growth policies.

- Jobs are created over a **long period of time** owing to delays in the dissemination of energy efficiency technologies and measures among consumers.

- This most often refers to **local jobs**, which can only have a positive impact on regional activity. This situation is due to the importance of energy efficiency measures, which include numerous services (sales, installation, etc.).

The regional character of jobs relating to energy efficiency is such that, in some northwestern states of the U.S., conservation and efficiency have become tools of regional development, as regions hit by high unemployment levels are encouraged to set up programs that are quite aggressive. These decentralized actions in energy efficiency matters highlight the importance of developing regional competency centres to provide consumers with more adequate information as well as all the necessary assistance.

B MACROECONOMIC IMPACTS

Several of Québec's basic economic structures will be improved because of a more efficient use of energy.

- The first structure affected by energy efficiency is, of course, **Québec's total energy expenditures**, namely, the energy bill paid by Quebecers as a whole.

  The quantified objectives retained by **Québec's energy efficiency strategy** indicate that, in 2001, Québec consumers would reduce their total energy expenditures by 1.5 billion dollars (in 1990 dollars) or 6%, compared to what these expenses would be without energy conservation.

  For individuals, the reduction of the energy bill would be proportionately still greater. It is estimated that in 2001 their expenditures alone would be cut by 12% (one billion dollars in 1990 dollars) as a result of a more efficient use of energy.

- Our energy consumption has a direct impact on our **external trade balance** because of the cost of imported energy sources.

  In the year 2001, the savings made in oil consumption would therefore cut the cost of petroleum product purchases by 0.7 billion dollars (in 1990 dollars) or 8%; this would have a direct impact on our balance of trade.

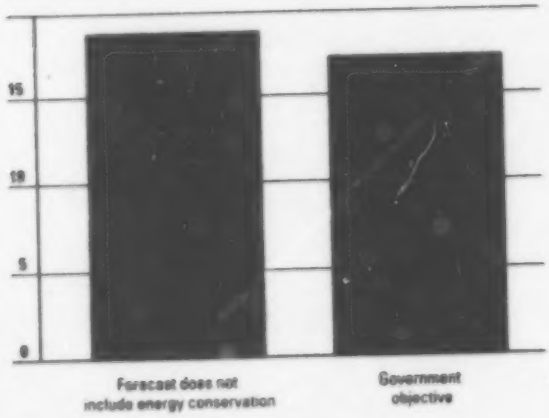
- **Québec's energy efficiency strategy** is intended above all to improve our economy's "energy productivity." We have seen previously that the results obtained over the past decade are very encouraging.

All the measures proposed or supported by the government would allow us to move still further. In 2001, energy consumption by thousand dollars of output would in effect stand at 0.31 toe, compared to 0.36 toe in 1988. On the "energy paths" we have drawn to compare Québec's situation with that of other industrialized countries (see Graph 4), Québec's economy would manage to hold its per-capita energy consumption at the current level, despite a significant increase in per-capita revenue. In ten years, Québec would thus be in a position to improve its **"energy intensity"*** by nearly 14%, using proportionately less energy to produce more wealth.

Graph 17

Impact of energy conservation objective on total energy expenditures – in 2001

In billions of 1980 dollars

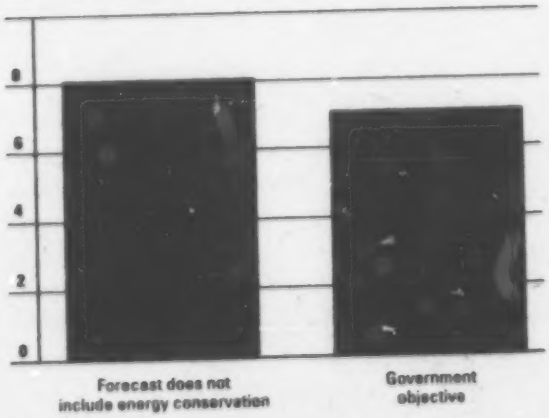


Source: Ministère de l'Énergie et des Ressources du Québec

Graph 18

Impact of energy conservation objective on energy expenditures of individuals

In billions of 1980 dollars

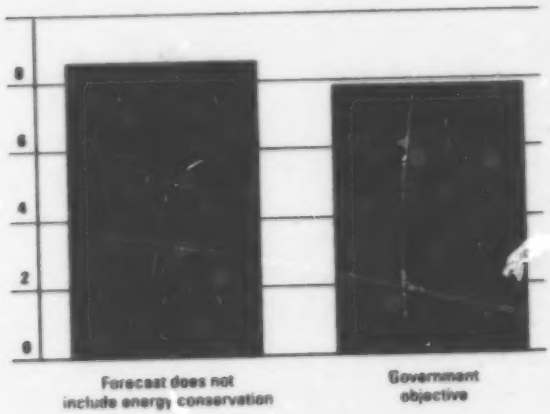


Source: Ministère de l'Énergie et des Ressources du Québec

Graph 19

Impact of energy conservation objective on the oil bill

In billions of 1980 dollars

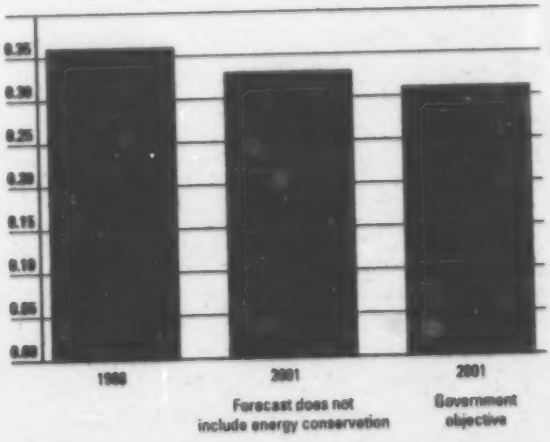


Source: Ministère de l'Énergie et des Ressources du Québec

Graph 20

Impact of energy conservation objective on energy intensity — Energy consumed by thousand dollars of output[1]

In toe



1. In 1981 dollars.

Source: Ministère de l'Énergie et des Ressources du Québec

C MICROECONOMIC IMPACTS: EXAMPLES

Québec's energy efficiency strategy entails that all consumers, in their environment, reduce their energy bill through concrete actions aimed at rationalizing the energy content of their activities. A few examples will illustrate the impact of these measures.

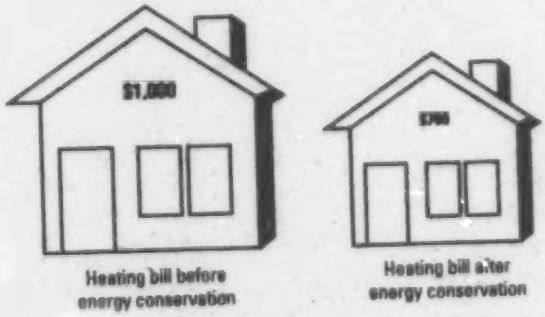
1 SINGLE-FAMILY HOUSING

For an average single-family home of 102 m² built in the early 1970s and whose heating bill stands at about 1,000 dollars a year, **Québec's energy efficiency strategy** recommends in particular the following measures: installing weather stripping around doors, replacing damaged windows, adding a door to the fireplace, and installing a programmable thermostat.

The combined effect of all these measures would enable this typical family to save up to 240 dollars on its yearly heating bill, or a quarter of its energy costs.

Graph 21

Impact of energy conservation measures on the energy bill[1] of a single-family home (in current dollars)



1. For the purpose of heating an average home of 102 m² built in the early 1970s.

Source: Ministère de l'Énergie et des Ressources du Québec

2 COMMERCIAL BUILDINGS

In an average commercial building with a total surface of 1,300 m², **Québec's energy efficiency strategy** recommends in particular lowering the temperature at entrances and adding protective covers to thermostats and indoor-outdoor thermostats for water heaters; it also recommends putting in building insulation when renovating the building (weather stripping, roof insulation).

These measures would save up to 4,000 dollars on a yearly heating bill of about 13,000 dollars.

3 PULP AND PAPER MILLS

If we consider an energy-intensive consumer (for example, an average-sized pulp and paper mill), costs can be cut by about 5% by applying measures whose recovery period is very short (less than two years).

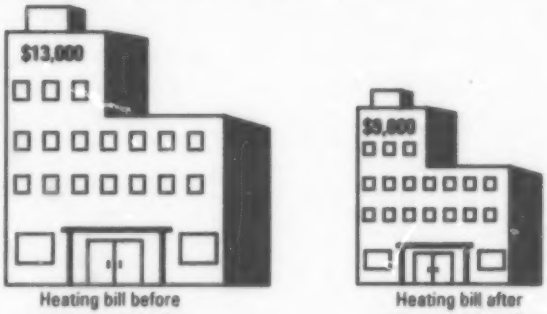
For example, measures relating to the boiler room, steam system and drying operations, evaporators, and other measures that relate to processes would cut heating costs by as much as 210,000 dollars from a yearly bill of 4,200,000 dollars in the typical case considered.

4 MID-SIZE CARS

Gasoline costs for compact cars (models such as Acclaim, Corsica, Jetta or Tempo) that travel 22,500 km per year on the average can climb as high as 1,380 dollars a year. By driving a sub-compact (for instance, Colt, Sprint, Golf or Escort) a car owner can save up to 380 dollars a year on gasoline. By downsizing from a standard-size car (for example, Crown Victoria, Bonneville, Caprice) to a mid-size car (Accord, Lumina, Taurus), a car owner can save about 200 dollars on gasoline.

Graph 22

Impact of energy conservation measures on the energy bill[1] of a commercial building (in current dollars)

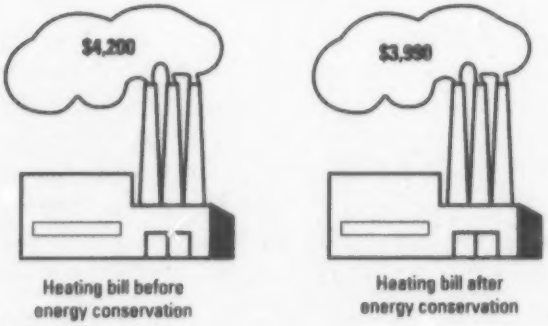


1. Corresponding to an average building of 1,300 m².

Source: Ministère de l'Énergie et des Ressources du Québec

Graph 23

Impact of energy conservation measures on the energy bill[1] of a pulp and paper mill[2] (in thousands of current dollars)

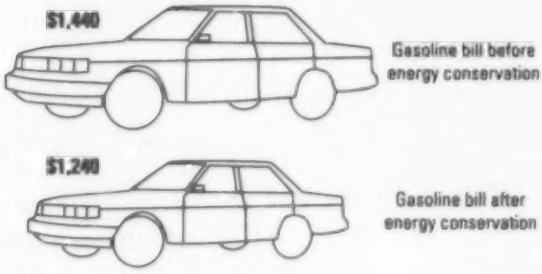


1. For heating purpnses.
2. Corresponding to an average-sized pulp and paper mill.

Source: Ministère de l'Énergie et des Ressources du Québec

Graph 24

Impact of energy conservation measures on gasoline expenses[1] for a mid-size car (in current dollars)



1. For cars travelling 22,500 kilometers per year.

Source: Ministère de l'Énergie et des Ressources du Québec

D ENVIRONMENTAL BENEFITS

1 INTERNATIONAL DIMENSION

We have already underscored that energy-based activities have environmental impacts, the most serious of which must be dealt with on an international level. Québec receives acid precipitations from the U.S. and the rest of Canada. The effects of carbon dioxide emissions are discussed mainly on a global scale because of the "greenhouse effect" many specialists say they cause.

- Environmentally, **Québec's energy efficiency strategy** must therefore be considered primarily as its contribution to a **continental and global effort to protect the environment**. By reducing carbon dioxide emissions, nitrogen dioxide and volatile organic compounds to a level below the one they would have reached without energy conservation, Québec is directly contributing to restore the earth's environmental balance.

- **Québec's energy efficiency strategy** will also have direct effects on the **quality of life of its citizens**, especially in urban areas. The presence of volatile organic compounds, nitrogen dioxide and tropospheric ozone in large population centres directly affects the health of individuals as well as the surrounding vegetation. The actions proposed by **Québec's energy efficiency strategy** should have a major positive effect on the air quality of Québec's large urban centres.

2 DIFFERENT IMPACTS DEPENDING ON THE ENERGY SOURCE

Québec's energy efficiency strategy will have different environmental effects depending on the energy sources concerned.

ELECTRICITY

We have emphasized the importance of Québec hydroelectricity as regards the environment. Contrary to other conventional energy sources, hydroelectricity does not cause air pollution and therefore protects certain environmental structures now considered to be the most threatened.

However, harnessing hydroelectric resources changes environmental conditions in the regions concerned because it entails physical developments. In this respect, a more efficient use of electricity will permit the construction of the required installations over a longer period of time and therefore help plan these facilities in the best possible way so as to minimize the expected impacts on the vegetation and wildlife of the producing regions.

— To meet its electricity requirements, Québec also relies — of course, in a very limited way — on energy sources other than hydroelectricity. Thermal production methods, such as the Tracy power station, spew pollution directly into the air. The energy efficiency efforts deployed, especially on Hydro-Québec's initiative, should have as their main effect to cut down on this type of production.

— Where Québec is in a position to export electricity, its electricity sales are for both parties a very advantageous environmental solution. On external markets, and in Québec in the longer term, this hydroelectricity replaces electricity produced from thermal power plants and therefore contributes directly to the reduction of air pollution caused by coal combustion, petroleum products or natural gas.

NATURAL GAS

Among fossil fuels, natural gas boasts greater qualities of cleanliness. However, it does cause some harm to the environment. Therefore, by slowing demand for natural gas, we reduce carbon dioxide, methane and, to a lesser extent, nitrogen oxide emissions. However, we should point out that substituting natural gas for heating oil is a plus for the environment.

Opinions differ on how much of the methane produced is linked to the use of natural gas. This output depends on the quality of transportation, distribution and combustion equipment used. Moreover, methane emissions related to energy consumption represent only a limited part of the entire production stemming from human activity. Indeed, almost all methane emissions into the

atmosphere are produced by the natural fermentation of marshes, rice pads, oceans and landfill, as well as by the consumption of petroleum products.

PETROLEUM PRODUCTS

— The rationalization of fuel oil consumption in the industrial sector cuts down on carbon dioxide emissions as well as sulfur dioxide and nitrogen dioxide production and therefore on the acidification of water and soil. The control of heating-oil consumption in urban areas would have the advantage of cutting emissions of volatile organic compounds, nitrogen dioxide, carbon dioxide as well as airborne particulates, thus substantially improving the air quality of the surroundings.

— The same can be said of the consumption of diesel fuel oil, which is responsible for a large part of airborne particulates.

— The major reason for cutting gasoline demand is because lower consumption reduces emissions of carbon dioxide; it also cuts down on volatile organic-compound and nitrogen dioxide emissions, which produce tropospheric ozone. This substance constitutes a considerable threat to the health of individuals as well as to plant growth, and can influence crop productivity — not only near urban centres but also over much of the surrounding regions.

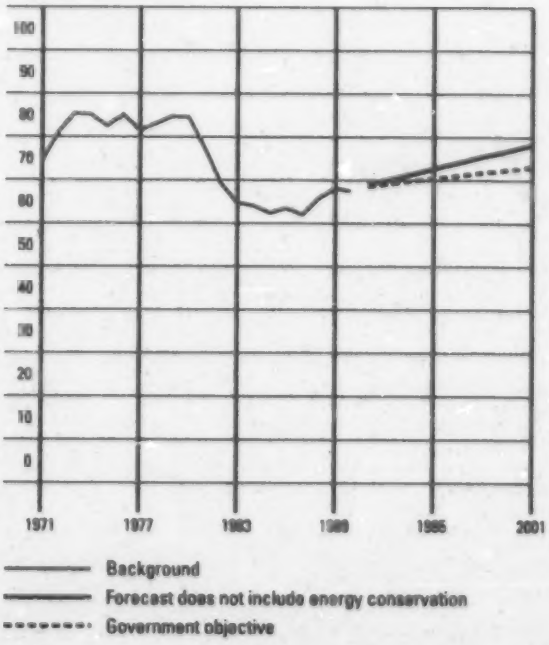
We can quantify at least one of the environmental impacts just mentioned. Based on the quantified objectives of **Québec's energy efficiency strategy**, carbon dioxide emissions associated with energy consumption would be 6% lower, in 2001, than the level they would have reached without energy conservation. Québec would therefore be able to confirm the performance already recorded on this score since the early 1980s.

Québec's energy efficiency strategy will have significant impacts on our quality of life and on the environmental structures we can influence. Above all, it will clearly show Québec's determination to do its part, as a province, to protect the environment at all levels: regional, continental and planetary.

Graph 25

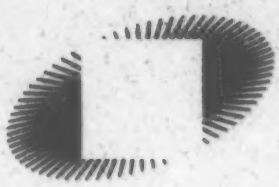
Carbon dioxide emissions in Québec – 1971-2001

In million tons



Source: Ministère de l'Énergie et des Ressources du Québec

CONCLUSION



Improving energy efficiency requires continued action from all participants. **Québec's energy efficiency strategy** basically lays out the road to follow and uncovers a certain number of paths leading to the stated objectives. As it will produce results over a long period of time, the targets identified as well as the means to attain them must be reviewed according to the progress of the various parameters that condition its implementation.

The role of the State in this field is to encourage a systematic and regular examination of the situation by all the interested parties and provide a certain number of indispensable common tools. This action reflects a true partnership between governments, companies and citizens; the objectives to achieve and the means to adopt must therefore be spelled out by all parties concerned.

GLOSSARY

COGENERATION **Cogeneration** is destined to play a relatively important role in Québec's energy sector in the 1990s. It significantly improves energy efficiency inasmuch as, in addition to electricity, it produces low-cost usable residual steam, either for heating space or in various industrial processes. In sum, **cogeneration** makes available two products, heat and electricity, with a 50% higher efficiency rate than that obtained from their separate production.

Cogeneration projects can include several energy sources, especially natural gas urban biomass and forest biomass. In the wake of a call for tenders by Hydro-Québec, several projects were submitted to the government corporation in each of these fields. The level of energy efficiency of the projects submitted is one of the criteria retained by Hydro-Québec in appraising the programs. By 1995, Hydro-Québec plans to purchase about 750 MW from independent producers, even more if Québec's energy needs require it.

AVOIDED COST In the preparation of energy efficiency policies and strategies, one of the concepts used is **avoided cost**.

The notion of **avoided cost** has been used particularly in the U.S. over the past few years, when passage of a section of the Public Utilities Regulatory Policies Act (PURPA) required utilities to purchase the output of independent producers. This was meant to set a fair price, thus protecting the utility's customers and fostering the development of new and diversified production sources.

More recently, this notion of **avoided cost** has been adjusted and used to calculate sums that could be earmarked by public utilities for various energy conservation programs.

a) The concept of **avoided cost** first of all raises the question of the **actual cost** of the energy produced or consumed. This actual cost can differ significantly from the price of energy sold on the market. There are several differences indeed between the energy prices billed to customers and the actual-consumption prices paid by the utility.

   - The first of these differences stems from the *direct or indirect support* given to energy companies. We are referring here to the financial support accorded directly or indirectly to energy companies by governments. The tax deductions granted to promote the exploration and development of oil and gas deposits, the support given to research and development, particularly in the nuclear sector, are the best known examples of this direct or indirect support.

     The evaluation of these support practices is relatively complex. It is however possible; it helps us quantify, if we wish, this first area of disparities between the market price and the actual price of energy.

   - The second difference between price and actual cost arises from *government services* that benefit some energy users.

     Thus, road construction paid by taxpayers as well as subsidized parking would both benefit car owners. These services reduce costs for car users, inasmuch as these costs are not entirely covered by gasoline taxes or other special taxes. In this case, however, price adjustments would cover the cost of service rather than the cost of energy.

     More recently, the Persian Gulf crisis highlighted the importance of military spending, which we can associate with the desire of Western countries to maintain current oil production and marketing conditions. Indeed, by intervening to prevent a Middle East country from controlling a major part of oil production, oil consumer countries protected themselves from excessive price hikes for oil supplies. An intervention of this nature, however, is not carried out solely for reasons of energy, and it is difficult to say with any accuracy what part of military expenditures should be attributed to defending oil prices. However, there is no doubt that all taxpayers share financially, through such measures, in price stabilization, if not reduction. The same is true, moreover, of measures relating to the buildup of strategic reserves or the continued operation of unprofitable pipelines.

Contrary to the disparities associated with direct or indirect subsidies, this is a field of analysis where assessments are difficult, even impossible, and where some people question the very practice of not transmitting actual costs on to market prices.

- A third reason for the discrepancy between actual cost and the price of energy is the recognition of the external effects of the production, transportation and consumption of energy on the environment. We are referring here to environmental consequences in a broad sense, which includes the health of humans and the characteristics of agricultural products.

  Energy activities have multiple effects on the environment. The various effects of such activities on prices are taken into account in part through investments that energy producers or users must make to limit the impacts of their activity.

  For example, the "Clean Air Act" translates, in the U.S., into billions of dollars invested in refineries, which is reflected in energy prices. Similarly, the increasingly strong regulations respecting fossil fuel storage and transportation, as well as the operation of coal-fired generating stations or nuclear power stations translate into costs that are passed on to consumers.

  This inclusion of the environmental consequences of energy activities is, however, merely indirect and fragmentary. In fact, it is virtually impossible to accurately assess the cost of all the damage done to the environment by energy production and consumption, and to infer the energy price increases that would result if we wanted to make up for them.

  Some evaluation techniques have been proposed in recent years. For example, an American utility, Bonneville Power Administration, polled its customers as to what they would be willing to pay to reduce — through energy conservation or greater recourse to alternative energy sources — expected environmental damage. Despite the interest aroused by these techniques, they do have a limited effect and, in any event, do not directly address the problem.

  We must recognize that we cannot accurately determine here the social cost associated with the production and use of each energy source. We can, however, take them into consideration by applying an arbitrary amount when we calculate the costs of the various possible energy supply sources. Such an approach, even if it seems artificial and therefore debatable, has the merit of illustrating and recognizing the concerns that must be addressed.

- To these three sources of discrepancies between price and actual cost, we can add a fourth one, which corresponds to the necessary integration of external economic effects of energy activities. Energy production, transportation, distribution and use have more or less significant economic spinoffs in a given society, and these spinoffs can be measured in terms of jobs and activities created.

  These external effects are not included in the price of energy sources, but are felt nonetheless when energy-related decisions are taken. In Québec's case, for instance, it is obvious that hydroelectric energy production has major external economic effects, compared to those resulting from natural gas or oil operations. The actual cost of energy, to be a reliable tool for decision-making, should therefore also integrate theoretically this external economic factor, which is not the case currently.

  As we can see, the **determination of energy costs** is hampered by the major difficulty of what to include: market prices reflect actual costs only imperfectly, and the corrections that can be made are far from being universally accepted.

b) Whether the cost retained is the market price or a price adjusted to respond to the previously noted disparities, **its use in decision making** seems to be obvious. Indeed, for energy producers, cost will be the main criterion among several. For example, to produce the energy its customers require, an electric utility will chose the least expensive solution: hydroelectricity, thermal power station, or nuclear power plant, depending on the situation.

The concept of **avoided cost** applies to the particular situation of an energy producer, who must chose between production and energy conservation, that is, between production and nonproduction, where nonproduction includes investments intended to allow consumers to cut demand. A producer who invests in energy conservation must earmark part of the company's funds to cut customer demand, which means less revenue for the utility.

From a company standpoint, such a decision is quite rational on two conditions: the price of energy must be set at the average cost, and the marginal cost of energy production must be higher than this average cost. The **avoided cost** is the marginal production cost that the company saves by not referring to a marginal production unit. However, since the company loses revenue from this production, it is only the difference between this **avoided** cost and the average cost that it can earmark for energy conservation. The company can finance energy conservation for an amount as high as the difference, without cutting its profits or increasing its production cost. This is the situation in the electricity production sector.

If the two conditions just stated are not combined, energy conservation cannot be compared to this difference. Such is the case, for instance, in the natural gas sector, where marginal unit costs of distribution are lower than the average cost, at least in the short term. This situation also prevails in the oil industry, where production optimization generally encourages companies to seek increased sales, either to make a refinery profitable or increase the profitability of the distribution network. In this case, economic rationality normally prevents a company from setting aside part of its funds for energy conservation.

This special situation of the energy producer-distributor does not mean, however, that the cost comparison is not valid for society as a whole. In effect, as a rule, the final consumers are the main beneficiary of energy conservation measures and, for them, the **avoided costs**, namely, the value of their consumption, are often greater than the costs of implementing the measures. For society, it is therefore a problem of cost-benefit distribution that limits the realization of the existing energy efficiency potential.

c) **Limiting the Use of "Avoided Cost"**

The use of the concept of **avoided cost** is therefore, in some cases, the basis of the financial involvement of energy producers in favour of energy efficiency. However, we have seen that entering costs did not take into account all the benefits society would receive from a more efficient use of energy. Above all, the price and cost structure of major segments of the energy sector — oil, natural gas — does not allow producers to directly raise the funds necessary to conserve energy.

This shows the importance of government action. By using their legislative or regulatory power and by taxation, governments can help achieve energy conservation that benefits all of society, when these energy savings are not ensured by market mechanisms. The State must therefore remedy the shortcomings — of economic calculations — that prevent the figures from perfectly reflecting the situation. However, it is obvious that such interventions must be spelled out and their effects carefully measured.

FROZEN EFFICIENCY The concept of **frozen efficiency** consists, when a demand estimate is being prepared, in calculating future energy requirements by "freezing," that is, maintaining unchanged over time, the energy efficiency of facilities and buildings recorded at a given date. We therefore do not take into consideration future technological developments that would improve still further the energy efficiency of new facilities. As for existing facilities and buildings, only the replacements made at the end of the service life of these facilities are included. The concept of **frozen efficiency** enables us to calculate demand forecasts excluding, for the most part but not entirely, "natural" energy conservation.

In the quantification presented for the period from 1980 to 2001 titled "Forecast before energy conservation," we have "frozen" the efficiency of facilities and buildings at their 1981 level.

TECHNICAL FACTORS EXPLAINING VARIATIONS IN ENERGY DEMAND Energy demand variations have traditionally been explained by **four separate factors:**

a) **Socioeconomic Requirements**

Energy consumption varies according to the number of housing units, household apparatus, motor vehicles, industrial machines and to how much commercial space there is. Most often, these numbers represent an increase, which therefore leads to higher energy consumption.

b) **Technology**

The technological characteristics of the equipment that transforms energy into useful work is continually improving. Gains in specific consumption are expressed in L/100 km for motor vehicles, in kWh/appliance for electric household appliances, or in toe/unit produced for industrial production. Because of this factor, energy consumption would tend to fall, were it not for increased energy needs. In addition, for some uses such as heating, we can distinguish a "basic technological factor," which concerns technological changes dealing with the object of energy conservation (insulation of housing units, weight and aerodynamics of vehicles) from an "efficiency factor," associated more directly with apparatus transforming energy into work (efficiency of burners using fossil fuels, of motors, etc.).

c) **Behaviour and Energy Efficiency Management**

This factor comprises changes in social and economic needs associated with personal behaviour (heating temperature, consumer habits, mobility) and production management (marketing structures and methods, use of industrial capacity).

d) **"Inter-energy" Substitution**

By replacing an energy source that is relatively ineffective for a given use by another that is more effective for the same use, we succeed in increasing efficiency and therefore in performing the same amount of work sometimes with much smaller quantities of energy (for example, by substituting efficient new electrotechnologies for conventional industrial stoking with fossil fuels).

ENERGY INTENSITY To measure the creation of wealth, economists generally use the concept of value added, which combines wages, profits and other remunerations that society draws from its productive operations. A country's gross domestic product (GDP) is the sum of all the value-added economic activities of that country. The GDP's **energy intensity**, defined by the ratio E/GDP, expresses the quantity of energy required to produce one constant dollar of value added to the economy. This ratio, as that of per-capita energy consumption, is one of the most commonly used to make international comparisons to measure the progress of a country's energy efficiency.

THEORETICAL ENERGY EFFICIENCY POTENTIAL To quantify Québec's **theoretical energy efficiency potential**, it was necessary to accurately define the context of the analysis performed.

a) This energy efficiency potential is derived from the **measures and changes** that could be applied, in certain conditions, to the ways energy is currently used. The nature of these actions and modifications has been clearly spelled out for the residential, commercial and industrial sectors as well as for transportation.

- In the residential, commercial and industrial sectors, we have narrowed the field of study to actions that reduce the overall energy contribution, without dramatically reducing or modifying the social or economic need at the root of energy consumption. For example, we have not considered possible measures that would have meant cutting heating and lighting requirements as well as those of motor power. Concretely, this means that we have excluded from the energy conservation potential the measures or actions that would entail **cutting back on the consumer's well-being**, on elements of the quality of life associated with energy consumption.

- In the transportation sector, such an exclusion was difficult to apply, for in practice it would have led to the rejection of most of the measures considered possible. Indeed, in this sector, except for actions dealing with the energy efficiency of motor vehicles, most of the measures generally proposed consist in finding ways to change the travelling habits of various customers and, therefore, to change the very basic social need found at the origin of energy use. The inclusion of these measures in the definition of the energy efficiency potential has broadened the "deposit" that we wanted to quantify, but it obviously constitutes a limit we must take into account in realizing this potential.

b) In the residential, commercial and industrial sectors, we have considered measures aimed at reducing **useful-energy** requirements as well as those effecting only **final energy**.

Useful energy is, in a way, the quantity of energy required to do work, such as heating, lighting or travelling. The energy to be used for final consumption (final energy) in various sectors is generally greater than useful energy because losses occur when it is transformed into useful work, due to the imperfect efficiency of the equipment.

- In the residential, commercial and industrial sectors, the measures retained concern useful energy as well as final energy. Here, the quantified theoretical potential comprises measures that reduce basic energy needs (better building insulation, better heating-ventilation management systems, renewal of steam systems in industry, etc.) as well as actions designed to improve the efficiency of equipment that transforms energy into lighting, heating or motors (installation of fluorescent lamps, replacement of obsolete burners with high-performance burners, etc.).

  In the long run, actions modifying **useful-energy** needs seem more attractive than those only affecting final energy because they make Québec a more efficient society, irrespective of the transformation equipment or particular energy source used. Energy requirements are in a way reduced at the very source.

  With respect to actions aimed at **final energy**, the net gains could eventually be cancelled out by new equipment, particularly when converting to another energy source. This type of actions is nonetheless important, especially if we think of the economic and environmental advantages for Québec to be gained from the greater efficiency of hydrocarbon-fuelled appliances.

- We should point out that this distinction has not been retained for the transportation sector, where the concept of useful energy is difficult to apply.

c) In this theoretical appraisal of the energy conservation potential, we have not considered **new technologies** for which available information was too sketchy, or insufficient. We are referring, for example, to infra-red processes, plasma torches and conduction heating in the industrial sector.

d) Based on actions and measures previously defined, the theoretical energy efficiency potential in the residential, industrial and commercial sectors has been identified by using technical and economic considerations as the sole evaluation criterion. In this sense, this theoretical potential can also be called **technical-economic potential**.

By retaining the **technical-economic potential**, whose definition is based strictly on profitability, we have included in the theoretical energy efficiency potential the impact of every energy efficiency measure whose **actual unit cost would be lower than the actual avoided cost or than the marginal production cost**, calculated on the "total useful life" of the measure.

For the purpose of calculation, an actual discount rate of 6.2% has been selected. This rate corresponds to the one used by Hydro-Québec in its profitability calculations applied to production as well as energy efficiency.

We have previously noted the difficulties in appraising an **"avoided cost"** that would take into account the various "external" impacts associated with energy consumption. As for electricity, we have retained Hydro-Québec's marginal production cost, inasmuch as this cost already includes certain environmental mitigation

measures. Regarding fossil fuels, we had to limit ourselves to current and expected average prices prevailing on the various markets, for lack of more precise information on the actual cost of these energy forms.

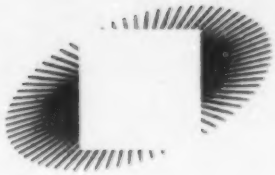
e) In the transportation sector, the theoretical potential could hardly be defined on the basis of strict technical and economic criteria, as in the residential, commercial and industrial sectors. Indeed, few indications are available on the economic advantages and costs of this or that change suggested by consumer behaviour and habits. For example, the use of public transportation and speed limits can mean for some customers a loss of efficiency, the costs of which should be kept in mind but are very difficult to assess. We have therefore made use of **scenarios** in this sector, clearly identifying changes in energy-use methods; the integration of these changes in the theoretical energy efficiency potential seemed justified.

f) The framework of the analysis would have been incomplete had it not specified the **time span retained**. For the residential, commercial and industrial sectors, as for transportation, only the energy conservation that could be realized within ten years has been considered, based on the rate of progress of the energy efficiency measures in the various markets.

g) In the determination of energy conservation, as in the quantification of the objectives retained, we must take into account the **"cross-effects"** and **"compounded effects"** of energy conservation measures.

- **Cross-effects** result from the fact that conservation measures dealing with certain uses can lead to an increase of energy consumption in other uses. This is so, for instance, in the "added heat" from lighting and the use of some electric home appliances that reduce the need for heating in winter. By improving the energy efficiency of these appliances, we increase to some extent heating requirements, which reduces accordingly the net effect of these measures. Major cross-effects have been calculated in the residential and commercial sectors, where data regarding particularly indoor heating were available.
- **Compounded effects** stem from the fact that results calculated for separate measures in a same market segment and for the same use cannot be added arithmetically, but combined instead by multiplying them. Indeed, the true impact of a measure can apply only to the net consumption resulting from energy conservation realized through previous actions in the order in which they occurred. This order of priority is therefore quite important and conditions in an important way the total compounded effect. That is why measures are usually classed by order of profitability, that is, beginning with the least expensive per energy unit saved. Effects have been so combined in all sectors.

TABLE OF FOLLOW-UPS



Energy Paths ____ 20

Association québécoise pour la maîtrise de l'énergie (AQME) ____ 27

Hydro-Québec's "Energy Efficiency Project" ____ 41

Actions of the Bureau de l'efficacité énergétique in the Building Sector from 1978 to 1991 ____ 47

Gaz Métropolitain and Energy Efficiency ____ 47

Actions of the Bureau de l'efficacité énergétique in the industrial and commercial sector ____ 49

Actions of the Bureau de l'efficacité énergétique in municipalities and RCMs ____ 51

Actions of the Bureau de l'efficacité énergétique in the public and parapublic sector ____ 51

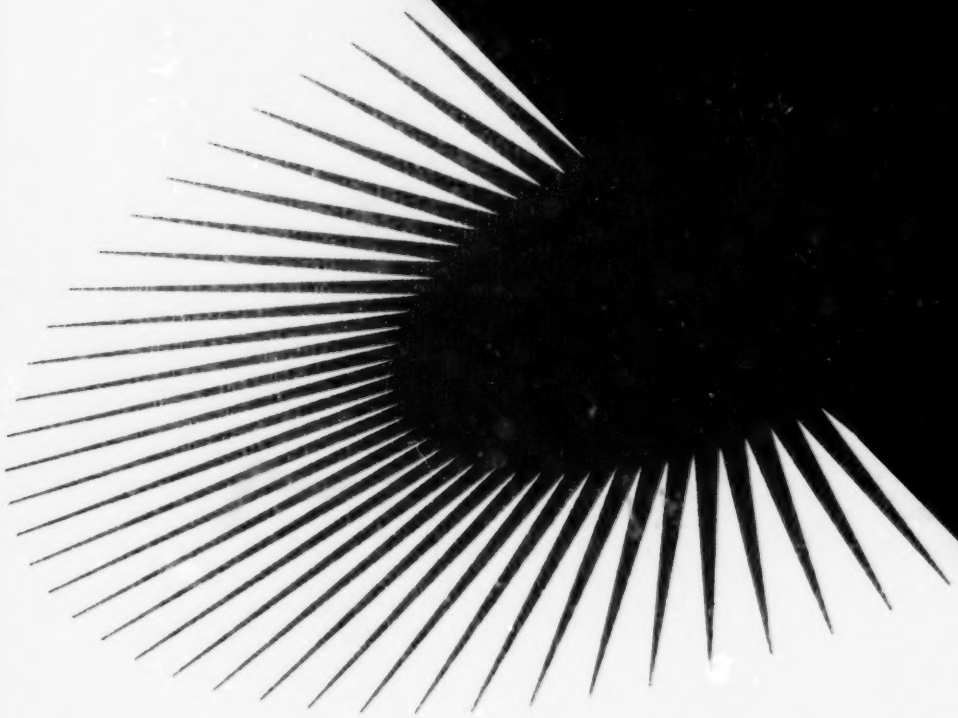
Actions of the Bureau de l'efficacité énergétique in the service sector ____ 51

Actions of the Bureau de l'efficacité énergétique in the transportation sector ____ 54

TABLE OF GRAPHS

GRAPH 1	Progress in Québec's energy consumption and economic growth — 1971-1990	18
GRAPH 2	Per-capita energy consumption — Québec, Canada and major industrialized countries — 1989	19
GRAPH 3	Energy consumption per thousand dollars of output — Québec, Canada and major industrialized countries — 1989	19
GRAPH 4	Energy paths — Québec and major industrialized countries — 1960-1989	21
GRAPH 5	Major hydroelectric producer countries in the world — 1988	25
GRAPH 6	Carbon dioxide emissions in Québec — 1971-1990	25
GRAPH 7	Per-capita carbon dioxide emissions — Québec and other Canadian provinces — 1989	25
GRAPH 8	Per-capita carbon dioxide emissions — Québec and major industrialized countries — 1986	26
GRAPH 9	Major aluminium producer countries in the world — 1989	26
GRAPH 10	Québec's theoretical energy efficiency potential — 1990	30
GRAPH 11	Québec's theoretical energy efficiency potential — 1990 Breakdown by demand sector	30
GRAPH 12	Québec's theoretical energy efficiency potential — 1990 Breakdown by energy source	30
GRAPH 13	Energy efficiency objective to achieve in Québec: what we could have saved in 1990	32
GRAPH 14	Québec's energy demand — 1988-2001	32

GRAPH 15	Energy efficiency objective to achieve in Québec — 2001 Breakdown by consumption sector	33
GRAPH 16	Energy efficiency objective to achieve in Québec — 2001 Breakdown by energy source	33
GRAPH 17	Impact of energy conservation objective on total energy expenditures — in 2001	72
GRAPH 18	Impact of energy conservation objective on energy expenditures of individuals	72
GRAPH 19	Impact of energy conservation objective on the oil bill	72
GRAPH 20	Impact of energy conservation objective on energy intensity – Energy consumed by thousand dollars of output	72
GRAPH 21	Impact of energy conservation measures on the energy bill of a single-family home (in current dollars)	73
GRAPH 22	Impact of energy conservation measures on the energy bill of a commercial building (in current dollars)	74
GRAPH 23	Impact of energy conservation measures on the energy bill of a pulp and paper mill (in thousands of current dollars)	74
GRAPH 24	Impact of energy conservation measures on gasoline expenses for a mid-size car (in current dollars)	74
GRAPH 25	Carbon dioxide emissions in Québec — 1971-2001	76



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